JPRS-CST-85-003

28 January 1985

China Report

SCIENCE AND TECHNOLOGY

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

JPRS-CST-85-003

28 January 1985

CHINA REPORT

SCIENCE AND TECHNOLOGY

CONTENTS

PEOPLE'S REPUBLIC OF CHINA

NATIONAL DEVELOPMENTS

ABSTRACTS

NATIONAL DEVELOPMENTS

REFORM OF SCIENCE, ENGINEERING EDUCATION

Beijing ZIRAN BIANZHENGFA TONGXUN [JOURNAL OF DIALECTICS OF NATURE] in Chinese No 4, 10 Aug 84 pp 3-5

[Article by Yu Zongsen [0151 1350 2773], of the Department of Physics and Chemistry, Beijing Iron and Steel Institute: "We Want to First Change Cognitively--A Discussion of the Problem of Reforming Science and Engineering Education"]

[Text] An important characteristic of the new world technological revolution is that production is progressively transforming from capital and labor intensive to knowledge intensive. Intellectual development and fostering of talent have prominent positions, for which reason education, and especially science and engineering at high level institutions, is at the vanguard of this battle. Science and engineering education urgently needs reform to more easily meet this new trend, and to produce even greater contributions to the stimulation of China's four modernizations.

Many aspects of science and engineering education need restructuring, but of foremost need is a transformation of understanding. We must change what we recognized in the past as correct but what is actually incorrect or one sided; otherwise, reformation of other aspects will not be able to progress. Those aspects of knowledge that I consider necessary to change are given below.

Are They "Rising Sun" Specialties or "Setting Sun" Specialties?

Some foreign advocates of a new Industrial Revolution call traditional or basic industry, like the steel industry, "setting sun" industry, and call some new industries, like the computer industry, "rising sun" industries. This has given rise to the question of whether "traditional" specialties of higher institutions that serve traditional industry are "rising sun" specialties or "setting sun" specialties.

Domestically, the majority of scholars consider that from the point of view of conditions in China there is still a great distance between the development of traditional industry and the requirements of the domestic economy. Regardless of what is said abroad, China's traditional industry still needs great development, and is certainly not a "setting sun" industry.

Can we conclude from this that to produce a corresponding specialty at higher institutions requires much greater development? I feel that we cannot, and that is because during the new technological revolution China's traditional industry cannot develop on the basis of past technology.

Rather, it must transform itself using new technology to develop on a new basis. Therefore, traditional specialties also need transformation, or they will become "setting sun" specialties. In for example the current mechanized specialties, if students are not taught a knowledge of computing and a knowledge of computer-aided design and computer-aided manufacturing, students will then be unable to meet the needs of their work even as they leave school. And since our specialist education must not only catch up with current trends, but must also face up to modernization, the rest of the world, and the future, therefore the transformation of "traditional" specializations is a matter of great urgency.

We must also realize that the proportion of China's college graduates to the population at large is still quite low, but from the point of view of the proportion of "traditional" specialists and technicians to the production quantity and value of traditional industry we are not less than foreign countries. In keeping with the transformation of traditional industry the production rate of labor will greatly increase. The number of workers will not greatly increase, and even if the proportion of technicians rises even higher the absolute number of technicians will not greatly increase. Therefore, older specialist estimates will not be expanded. At present the "traditional" specialties at some schools have already faced the problems of the merging of specialties and reductions in the numbers of new students. We must realize that this situation is not likely to change, and "traditional" specialties should adopt corresponding policies.

In another aspect, the new specialties serving the so-called "rising sun" industries need to treat the transformation of traditional specialties as a main point in the development of new specialties, for otherwise it will be difficult for "rising sun" industries and specialties to develop. Even though much fuss has been made about "setting sun" industries abroad, no up and coming scholar has said that traditional industry is unnecessary. We ought to notice that one of the important reasons that the sun is setting on Western traditional industries is that they cannot overcome competition from developing countries, and it is not because they are voluntarily abandoning traditional positions. At the same time, they are making use of the economic recession to carry out a readjustment, and are using new technology to transform traditional specialties.

Will It Be "Ardent Devotion to a Specialization" or "Be Prepared to Change?"

There was a precept about the work of education in past academic thinking, which was "Devote yourself to your specialty." It began as soon as students entered school, as they were told how good the specialty was. This principle was learned from the Soviet Union. This teaching of the devotion to specialty is combination with the narrow scope of the specialty also narrowed the thinking of the student, the negative consequence of which is that at present many

middle aged graduates from science and engineering colleges do not meet the requirements of developments in new technology either theoretically or vocationally. Primarily, it is a narrowness in thinking. In addition to the narrow scope of their specialty, they cannot get interested in other things and have made limits for themselves. In addition, when people get older their energy is not as great as before, and it is not as easy to learn new things. That is why I say that this teaching of one-sided devotion to specialty is in reality an obstacle to technological development.

Of course, that students understand their specialties and be devoted to them is necessary. Otherwise there will be no advance made in the specialties. But looking at the whole picture, we do not want to make specialties too narrow, and even more importantly, we want to help the students establish the concept that the subject matter of a specialty is constantly changing. In addition, we want to encourage students to prepare to make new things in interdisciplinary programs and integrated disciplines. We want students to not only devote themselves to things within the scope of their specialties, but to be interested as well in things outside of their specialties. And we want them to be prepared to eliminate things within their specialties that are obsolete as necessary, and to add new and advanced things.

Do We Want to Readjust Inwardly or Expand Outwardly?

Our specialty divisions have been learned from the Soviet Union, then later altered and strengthened to be even more refined that those of the Soviet Union. Although we are now undergoing a amalgamation and readjustment there are still more than in the Soviet Union, not to mention the systems of capitalist countries. To now address the question of meeting the challenge of the new technological revolution, once again brings up the discussion of whether to establish new specialties. I believe that particular new specialties ought to be set up, but in general should depend upon the readjustment of the content of existing specialties to suit changes in conditions. Otherwise, the new specialties will possibly be led onto the disastrous path of narrowness and unsuitability of specialties. The college system in capitalist countries depends upon readjustment of existing content to meet changes, as with their "old" departments of mechanics and electronics, which are largely intact, but the subject matter of which has long departed from the complete "classical" subject matter of mechanics and electronics. Moreover, not every school is alike, being of a wide variety, each with its strong points. In the meantime some of our specialties still are disposed toward effort spent on attracting students, and they make themselves sound new during recruiting to encourage students to take entrance examinations, but their subject matter is still old stuff, and it is obvious that this is not a method to adopt.

A Finished or Unfinished Product?

High level science and engineering schools have in the past made many specialty investigations, at which time they evaluated one of the important indications of whether the talent they fostered met the requirements, and that was whether students were able to immediately pick up their jobs when they took up their positions. Enterprise also often uses this principle to evaluate

whether the running of a school fits the principle of connecting theory with practice. The consequence has been that in school planning hands on technology and talk about practical things have occupied much school time. These things do not differ much from curricula in middle level schools, and crowd out time for students to study theory and fundamentals. This is an important reason why students lack an ability to be flexibly used and have insufficient staying power.

Capitalist countries consider college students as half-finished products, and that the companies that hire the graduates train them further is considered a natural thing. They depend upon appropriate training after graduation to make up the deficiencies.

In the past we valued highly planning for training talent, but many years of actual experience has shown that that is not the complete picture. Especially now with the rapid development of modern technology, sole reliance on studying something in college is fundamentally insufficient for the needs, and examples of graduates changing professions or changes in the focus of specialties can be found everywhere. And this is not in the least strange, for how could the science and engineering education of the 1950's prepare people for today's broad utilization of computers? And to complain that science and engineering colleges in the 1960's paid too little attention to the teaching of lasers and optical waveguides is also not reasonable.

In order to keep up with rapidly changing trends, the only basis is to improve students' theoretical base and training in fundamentals. Although the range of our specialties are not necessarily as broad as those of capitalist countries, it is still necessary that they be broader than at present. If we train students to be good half-finished products or vessels during the college period, and figure that when they go to their positions they can quickly match up to the particular conditions of the position, then in not too long their usefulness will be developed. Years of practice have shown that if science graduates are not contaminated by the deficiencies of taking facts lightly and having higher aims than abilities, their grasp of reality is not necessarily less than that of engineering graduates, and are certain to have great staying power. Those science graduates who study engineering at the graduate level are often more successful than those who are trained as "professionals." This experience is a powerful revelation for the restructuring of our modern education.

During the time they are in school, students must spend a certain amount of time understanding and familiarizing themselves with the reality of their specialties, but the goal is to learn theory on the basis of practical experience. Because not having actual practice is to violate a fundamental principle of the theory of knowledge, and theory will not be learned well.

Under current deliberation is the question of changing major high level school systems from four to five years. The suggestion is that the first 4 years will chiefly create a basis (including basic specialized courses), and that after the four years they prepare for assignment by undertaking in the 5th year appropriate training based on the requirements of the student's intended position, all to achieve a unification of suitability and appropriateness.

What Should Be Considered a Good Teacher?

For a long time now we have been praising the kind of teacher who is responsive to students, takes great pains with them, runs to their dorms everyday to answer questions, and will absolutely not allow a single class member to drop out. The diligent attitude and sense of responsibility of this kind of teacher is still worth study and praise today, but the overall methods are still incomplete.

In my opinion, foreign college teaching is not as diligent as it is in China, and their teaching methods are even less fastidious. The theoretical knowledge of our college students and specialized subject matter are definitely not inferior to that abroad, nor is what we learn since we even teach more and learn somewhat more. Even though this is true, foreign countries have produced much great talent. Everyone agrees that our students lack hands on ability, and that ability to analyze and solve problems is insufficient. In addition to objective factors, I believe this has to do with our training methods. Just as when teaching someone to swim, when left alone the student will take in a lot of water and might even nearly drown, but if one were to always keep hold of students, they would never learn to swim. Our problem lies in the fact that we too seldom release our grip. Ordinarily when students are force fed too much, they will only learn that which is within their vision. Only by fostering their abilities to learn by themselves will they be made to continually absorb new knowledge throughout their lives. If we do not allow students to plunge forward into the sea of knowledge then we cannot train them in the skill to extract knowledge on their own. If we allow them to plunge ahead then we cannot avoid allowing them to occasionally falter, to take a few extra steps, nor can we avoid particular obstructions. But, in the interest of training a contingent to make a hard fight before the onrush of new science and technology, we must adopt this method. A teacher's sense of responsibility ought still to emerge from this respect. The only relatively comprehensive method is on the one hand to teach with tireless zeal, and on the other to also dare to release one's grip to allow students to learn for themselves, and to not fear that they will go astray or run into a wall.

12586
CSO: 4008/402

PROVINCIAL S&T TASKS FOR 1984

Changsha HUNAN JINGJI XINXIBAO in Chinese 5 Apr 84 p 4

[Text] To implement the strategic principle put forth by the Party Central Committee that "to develop the economy, we must rely on science and technology, and science and technology must be geared to the needs of economic construction," and in line with the situation in Hunan, the provincial science and technology plan for 1984 is as follows:

Agriculture is the foundation of the national economy, and the key science and technology problems in the area of grain to be tackled in Hunan this year are "the breeding of hybrid paddy rice combining high quality, multiple resistance and high yield, xxxcxxxxxxxxxxxxxxxxxx and the study of mechanisms," the "application of systems engineering in agricultural production" and other projects. In order to raise the economic results of Hunan's agricultural production, we are also paying attention to problems in the areas of animal husbandry, aquatic production and cash crops. The areas of animal husbandry and aquatic production primarily involve "the development of feed sources and the study of animal rearing technology," "the study of cross-breeding and improving hogs to raise the lean meat ratio," "the study of commercial fish culture for inland lakes and reservoirs," and "the study of special aquatic products," etc. In the area of cash crops, we will stress "the breeding and comprehensive utilization of new varieties of cotton that are non-toxic and disease resistant," "the breeding of improved varieties of ramie and technology for rapid ramie raising," "tea processing technology," "the breeding of high yield and high erucuc acid, varieties of double low [Shuang di 7175 0144] rape and technology for the processing and utilization of rape" and the development of a coordinated process for mandarin oranges and yangtao (Actinidia chinensis), etc. In order to comprehensively promote the development of Hunan's agricultural production and the whole economy, the provincial science committee has already decided to make the four counties of Hanshou, Suining, Hengdong and Liuyang that are spread over lake, mountain, hilly and semi-hilly semi-mountainous areas into key counties relying on science and technology to develop and promote the economy.

Neither the development of Hunan's industrial production nor the overall economic results of its industrial enterprises are sufficiently ideal. In order to change the appearance of Hunan's industrial production, this year the provincial science committee will coordinate the concerned departments

responsible for the work to do a good job with the technical transformation of the three experimental science and technology plants--the Shaoyang city leather manufacturing plant, the Jianxiang porcelain plant and the Linxiang county nitrogen fertilizer plant.

In the field of food processing, apart from continuing to study the question of new technologies and new products for staple products such as tobacco and liquor, we must also get a good handle on studying infant and health food products such as the in depth processing of husked rice (like convenience rice flour and convenience cooked rice) and soy bean milk.

In the field of textiles, we will stress the study of the development of a coordinated process for improved varieties and capital construction for ramie, restructuring of processing technology and new ramie textile products. We will also assist production departments in developing jute carpets.

In the fields of metallurgy and construction materials, we will stress the overall recovery and utilization of nonferrous metals, the comprehensive utilization of pulverized coal in thermal power plants.

Insufficient energy has been one of the main reasons all along limiting the development of the province's economy. This year, in addition to continuing to set up projects that have already attained significant positive results by stages such as planning the comprehensive utilization of electric generation by bone coal, improving the management of mass motion at hydroelectric station reservoirs and economizing in the use of kitchen stoves, etc., we are also planning the study of energy saving technology and energy saving electromechanical products. Besides this, this year we are also emphasizing the task of arrangements for microelectronics, first, by application in management and production process control in plants and enterprises, and we also want to energetically extend it to various economic administrations in order to raise work efficiency. This will allow Hunan to leap to the forward ranks of the nation in the "new industrial revolution."

12452
CSO: 4008/277

LI LIAN ADDRESSES SCIENTIFIC ANNUAL MEETING

SK280142 Harbin Heilongjiang Provincial Service in Mandarin 2200 GMT 27 Dec 84

[Excerpts] The provincial advisory commission of science, technology, and economy held its annual meeting on 27 December, at which (Deng Sanli), chairman of the provincial advisory commission, summed up the commission's work done over the past 15 months and put forward work arrangements for 1985.

Attending the annual meeting were Li Lan, secretary of the provincial CPC Committee; Chen Lei, deputy secretary of the provincial CPC Committee and governor of the province; and Zhu Dianming, standing committee member of the provincial CPC Committee and chairman of the provincial scientific and technological commission.

In his work report, Chairman (Deng Sanli) stated: In the upcoming new year, by implementing the spirit of the 3d Plenum of the 12th CPC Central Committee, the provincial advisory commission of science, technology, and economy will engage in studies and appraisal on the programs of conducting reforms among urban economic systems, of implementing the strategies of provincial and regional development, and of developing economic ecology, as well as on other important issues.

At the meeting, Li Lian and Chen Lei delivered speeches in which they fully acknowledged the work achievements scored by the advisory commission and extended appreciation to the commission's experts.

Li Lian stated: In the upcoming new year, both provincial officials and scientific and technological personnel will have to bring about a change in their ideology. Leading organs and cadres should further rely on these experts who should also get closer to the organs and cadres. Work emphasis should be put on studying and solving the practical problems of the economy and technology. Attention should be paid to increasing economic returns.

Li Lian also urged the experts to offer their proposals as soon as possible in line with the important provincial macroeconomic policies concerning the power industry, animal husbandry, diversified economy, personnel training, and technical and personnel introduction so as to help leadership work out important decisive plans and targets and to achieve rapid development in the provincial economic and construction undertakings.

At the meeting, a large number of experts and specialists put forward valuable proposals on some important issues concerning the provincial economic construction and on the future work of the advisory commission.

CSO: 4008/171

ZHOU HUI ATTENDS SCIENTIFIC WORKERS' FORUM

SK250547 Hohhot Nei Monggol Regional Service in Mandarin 1100 GMT 24 Dec 84

[Excerpt] The 4-day forum to invite scientific and technical personnel working outside Nei Monggol to return to the region to offer plans and suggestions for economic construction ended in Hohhot on 23 December.

Zhou Hui, secretary of the regional CPC Committee; Bu He, deputy secretary of the regional CPC Committee and chairman of the region; and Tian Congming, deputy secretary of the regional CPC Committee, attended the closing ceremony. Comrades Zhou Hui and Bu He alighted from the rostrum to present certificates of honor to participating comrades who have supported the border regions for more than 20 years. The assembly hall resounded with rousing applause, permeating it with an enthusiastic atmosphere.

At the forum, Comrade Zhou Hui expressed thanks to 35 scientific and technical personnel who had been invited to the forum to offer plans and suggestions. He said: Modern social science and technology are changing every day. We name this an era of knowledge explosion. Comrades here had sweated for the region in the 1950's and 1960's and contributed to building New Monggol. We will not forget all of you. I hope you comrades will understand and forgive us for our inadequate services in the past. We have already done something under the guidance of a series of relevant guidelines of the CPC Central Committee on respecting knowledge and talented persons. In the future, we will do a better job in this regard. We hope comrades will work together with us.

CSO: 4008/171

SU YIRAN ATTENDS TECHNICAL AWARD MEETING 5 JAN

SK060730 Jinan Shandong Provincial Service in Mandarin 2300 GMT 5 Jan 85

[Excerpt] The 1983 outstanding scientific and technical achievements award meeting was held in Jinan yesterday morning. Attending the meeting were responsible comrades of the provincial CPC Committee, the provincial people's congress standing committee, the provincial government, and the provincial CPPCC committee, including Su Yiran, Lu Maozeng, Wang Jinshan, Xu Jianchun, Lu Hong, Ma Changgui, Song Yimin, Zhu Qimin, and Li Zichao, as well as members of the scientific and technical leading group of the provincial government.

Under the guidance of the CPC Central Committee's strategic policy that economic construction must rely on science and technology and that scientific and technical work must cater to economic construction, the broad masses of scientific and technical workers across the province have boldly scaled the heights of science, studied hard and conducted research painstakingly, boldly explored new things,and scored achievements in a great number of important scientific and technical findings. According to statistics, the province as a whole had 977 important scientific and technical findings in 1983, an increase of some 200 over 1982. Of these, 26 reached or approached the advanced international level and 378 findings reached the advanced national level. These findings have been popularized and applied to production in a varying degree. Remarkable economic results were made. The decision of the provincial scientific and technological commission on commending and awarding the province's 1983 scientific and technical findings was read at the meeting. Some 219 outstanding scientific and technical findings of 1983 were recognized.

Su Yiran, Lu Maozeng, and other leading comrades presented cash awards and certificates of citation to research units and scientific and technical workers.

Ma Changgui, vice governor, delivered a speech at the meeting.

CSO: 4008/176

ECONOMISTS SHOULD PAY MORE ATTENTION TO S&T

Beijing GUANGMING RIBAO in Chinese 19 Mar 84 p 1

[Article by Xie Ni [6200 1441], economist and deputy director of the Zhuzhou Municipal Economic Committee]

[Text] The Zhuzhou Electronics Research Institute's change from receiving operating expenses to a renumerative contract system and its going the route of being responsible for its own profits and losses has presented economists with a problem: What should we be most concerned about? Our city has 13 research institutes, and apart from a few fairly prosperous research institutes which have adopted similar methods, most research institutes are having a rather difficult time and have had no breakthrough. One of the reasons is that the system is rather rigid and lacks a set of policy measures appropriate for small and middle scale research institutes and they basically rely on "fees based on the number of people" for their livelihood, become part of an administrative organ, and depend on eating from "the same big pot" to get along and lacks impetus, force and vigor.

Our city has 1,226 industrial enterprises but comparatively few scientific and technical personnel. The scientific and technical personnel in enterprises that are directly under the city constitute only 4.26 percent of all staff and workers. There is a wide and pressing need in the city's industrial enterprises to develop new products and new technologies, but because we lack talented people, our competitive capabilities fall short. On the other hand, our city has a number of specialized research units with concentrated knowledge and unused vigor. Of course, there are many reasons contributing to this contradiction, and of them, the inappropriateness of concrete policies and organizational systems is a major factor. To handle these small and middle-scale research institutes well and in a vigorous way, we must break out of the present administrative management system and economic system and the conditions that are not suited to the spirit of restructuring, relax policies, smash the situation of eating from the "big rice bowl," give research institutes the necessary economic energy and autonomy, mobilize their enthusiasm and initiative, produce more achievements and results and allow research institutes to be able to develop themselves through their own initiative. The state must press scientific research institute to cater to the needs of production through policy measures in order to enable production to achieve even greater positive results. The development of production, on the

other hand, must promote the further development of scientific research institutes, and in this way, scientific research and production can then join even more closely together.

Local research institutes rely on the method of operating expenses being handed down in a lump sum, which seems to "ensure stable yields despite drought or waterlogging;" in fact the enthusiasm of scientific and technical personnel cannot be fully put into play, and even with increased state expenditures, scientific and technological enterprises do not develop. I feel that we can learn from the experience of the Zhuzhou Electronics Institute, and relax policies in the areas of economic, finance, tax revenue, etc., adopt these concrete measures, and with the condition that the state provides a certain amount of support, let them rely on themselves, find their own business, take responsibility for profits and losses, accumulate funds and develop scientific research. Only in this way can the road [to economic success] be ever longer and broader.

First, we must change the life-time "fees for each person" to a one time disbursement of loan. Let them use this limited start-up money as capital, make overall arrangements, and seek their own benefits. We must give them financial autonomy and let them have a free hand. Second, we must change administrative-type research institutes to a research and economic entity with a set income. Each research institute should manage by itself, or have the department in charge set aside a rather high-quality small-scale enterprise with one or two major products as its experimental plant, internally audit themselves and externally have one bank account. In this way, they can both guarantee the fixed income of the research institute and can also be a Chinese style base. Third, tax revenue should be exempt for the transfer of scientific research results, technological service, technological consultation and chemical testing, and other non-fixed income, because the income from these projects is not great and their value is primarily manifest in social benefit. Fourth, we must clarify regulations: small-scale research institutes with a net annual income of about 10,000 yuan should be tax exempt for the amount under about 10,000; medium-scale research institutes with an annual income of over about 10,000 yuan should be exempt from taxation on about 10,000 yuan. The part above that should be taxed like a number. Fifth, for the net income remaining after the scientific research institute pays taxes, they must set rough distribution proportions. We can figure that in principle, 50-60 percent be used to develop scientific research, 20-30 percent be used for the collective welfare, and 10-20 percent be used for awarding people. The award money for research institutes should not be included in the total sum controlled by the local production award. Scientific research personnel will implement the responsibility system, choose their own tasks, be responsible for their expenses, and give awards according to economic results. Only in this way will they truly be able to give expression to the principle of more gains to those who contribute greatly, smaller gains to those who contribute a little and no gains for those who contribute nothing, and only then will we be able to thoroughly change the situation of eating from a "big rice bowl," and effectively mobilize the enthusiasm of scientists and technicians.

If we are able to adopt these policy measures, then research institutes will be able to have impetus, force and vigor. The Zhuzhou Municipal Electronics Institute has now taken a step, and even though there were considerable difficulties, they are still not perfect and there has been some criticism, 5 years of actual experience has proved that their restructuring direction was correct and that they have great vitality. When that institute began operations, public finance loaned it 800,000 yuan and a bank supplied some money, and all has already been repaid. They relied on themselves, dared to do pioneering work, and provided users with several dozen achievements of scientific research one after the other, developed technical service, and earned a net income of over five million yuan. Both personnel and scientific research methods increased, and there is still an accumulation of over 1.7 million yuan. There is even less of a way to calculate the social and economic results of their transfer achievements and technological service. Why not go ahead with all of those good things that kill several birds with one stone, like those that are good for increasing the state's income and reducing expenditures, good for developing scientific research to promote production and technological progress and good for raising social and economic benefits and developing the economy.

If we wish to do a good job with small and medium-scale research institutes, we must still adopt concrete measures and clear out the channels for scientific research and production. Management, economic, accounting and scientific committees must play the "red maiden" and act as go-betweens. In direction, research departments must gear themselves to production and to application; production departments must take the initiative in seeking "talent" and provide convenience. In the area of economics, operating expenses for scientific research and technology should be fair and reasonable--"high production, small profits and more income;" when production units pay expenses in this area they should make the source of funds clear and open up channels of communication. Funds that are used solely for enterprise production, personal depreciation funds, expenses for the trial manufacture of new products, etc., can all be applied to this category of expenditure. Plant and enterprise expenses used for purchasing successful results and technology, in turn, should be allowed to be included in capital or else returned from the new increased beneficial results obtained after applying the new technology. If we do not open up new sources of funds in this way, then even though both sides (research institutes and enterprises) may be willing [to work together], if the enterprises have no money, they might as well gaze at "science" and sigh; and the research institutes might as well submit to anyone that pays them in order to earn an income, and this could easily become a biased direction.

12452
CSO: 4008/277

GUANGMING RIBAO ON TECHNOLOGICAL TRANSFERS

HK270810 Beijing GUANGMING RIBAO in Chinese 16 Dec 84 p 3

[Article by Jin Zhude [6855 2612 1795]: "Open Channels for Technological Transfer"]

[Text] In a developed commodity society, technology is also a kind of commodity. This is not only because technology at this stage has the general characteristics of a commodity, but also because the process of technology's turning into production capacity through exchange is quite similar to that of common commodities.

The "production" of technology refers to the process of research, invention, and creation, and the product is the research achievements and new technology. After a new technology is produced in a research unit, it will enter the field of circulation and eventually reach the field of "consumption" through exchange, thus turning into actual production capacity. In a usual case, a new technology must go a long way in the field of circulation and pass many "tests" before it can come into play in the production process. In general, there are two main forces that push it through the field of circulation. One is the administrative force, and the other is the economic force. The handling of a new technological achievement includes two aspects. The first includes the registration, assessment, appraisal (offering rewards), development, and promotion (patent offers also belong to this aspect); and the second includes the formulation of some policies for the circulation and exchange of this technological achievement and the formulation of plans and measures for developing, promoting, and applying some key technologies in a coordinated way. The so-called economic force is effected through the use of economic means in light of the law of value. It will help channel the technological achievements into production units and turn them into actual production capacity through the opening of technology markets and by means of trade.

The technology markets are a product of the full development of the commodity economy. In the past we lacked a correct understanding of the commodity economy, and used to regard it as an opponent factor to socialism. We did not recognize that technology is also commodity and also has an exchange value. So we forbade the compensable transfers of technology, and as a result there was no technology market and no technology trade. Under these circumstances, the transfer of technology could only be handled by administrative means alone.

However, the administrative departments concerned did not take technology circulation (or the whole set of work concerning the management of technological achievements, as we used to say) as a bridge or a link between scientific research and production so as to manage it in a comprehensive and systematical way. Rather, the work concerning technology transfer was divided into a number of specific parts which were assigned to separate functional departments. For example, the registration and assessment of technological achievements was handled by scientific and technological information units; the issuance of rewards was decided by the scientific and technological management departments; the work of popularizing new technology and promoting the exchange of technology was the duty of various research institutes; and no specific units took charge of the work of developing new technology. There did not even exist a patent system whatsoever. As a result, technical personnel and research units had no way to promote the application of their new technological achievements and receive no benefit, and this certainly dampened their enthusiasm.

The "CPC Central Committee Decision on Reform of the Economic Structure" adopted by the 3d Plenary Session of the 12th CPC Central Committee clearly points out: "The full development of a commodity economy is an indispensable stage in the economic growth of society and a prerequisite for our economic modernization. It is the only way to invigorate our economy." In recent years the compensable transfer of technology and the emergence of a technology market have greatly promoted the development of the national economy as a whole, and have also proved the correctness of the Party Central Committee's decision. From emergence to full flourish, the technology market in our country has developed almost with the speed of a whirlwind. In 1 to 2 years, all kinds of technology development companies, consultant companies, and development companies have sprung up like bamboo shoots after a spring rain. Technology trade has become an important component part of our socialist economy. According to rough statistics from a number of provinces, the value of technology transfers from the military industry to civilian industries alone amounted to more than 300 million yuan this year. At present technological exchanges are very brisk in all parts of the country. Technology exhibitions and sales fairs have attracted thousands and thousands of enterprises. Technological information has become the hottest commodity. In the course of extensive technological exchanges, the value of technology has been recognized, and so has the value of intellectuals and mental work. Diplomas and various educational certificates have also become more and more valuable. Studying technology and seeking more knowledge has become the order of the day. The initiative of intellectuals has been aroused and their role has been brought into better play. The educational level of the broad masses has gradually been raised. This will inevitably promote the rapid development of science and technology and will give rise to more and more technological achievements. The technology market will become ever brisker. This will precisely be a benign cycle which promotes the prosperity of our socialist economy and our scientific and technological undertakings.

However, we should also notice that some problems in the management of technology transfer should be urgently solved. For example, there are the following problems in economic management concerning technology transfer: First, although many "companies" and "centers" now have been established, people still do not quite know how to operate these organizations. In particular, they do

not know the process of inviting tenders, entering bids, and signing contracts and the essence of these procedures. Therefore, cases related to infringements upon others' rights, violations of contracts, and business disputes have occurred frequently. Some units and individuals have even broken the law in conducting business. Although some enterprises have accumulated quite a few technological achievements, they still cannot properly transfer them to make a profit because they do not know how to handle this business or how to run the organizations engaged in technology transfer. Second, before entering the market, technological achievements always have to undergo a process in order to turn themselves into commodities, and that is the technological development work, as we often say. Technological development requires some funds. Because it may succeed and also may fail, investment in technological development is called risk investment. At present a prominent problem is the insufficiency of funds for technological development. This is related to the thinking of some authorities concerned. They think that investment in technological research and development must have guarantees, and funds appropriated to enterprises for technological transformations must also have guarantees. As a result, funds for technological development are always insufficient. Third, there should be competition in the technological market, and only by taking an active part in the market competition and winning in it can an owner of technology continue to develop it. However, many people now still think that they may make a good fortune for a long time by monopolizing an advanced technology. This does not conform with socialist principles and is not a practice of high-minded people. Of course, we should protect people's right to their knowledge and technological property. But the protection of property rights is to encourage competition rather than secure a monopoly of technology. To win in the competition, one should have three conditions: 1) The technology one provides should be of high quality; 2) the price should be reasonable; and 3) the technological service should be good. Among other things, the quality of technological service has a bearing on the application of the technology and also on the reputation of the supplier of the technology. However, people have not paid sufficient attention to this work yet. Fourth, the transfer of technological achievements is not merely the circulation of technology; it also includes technological consultation, tendering for and contracting projects, hiring technicians from research units on a short-term basis, and technicians' sparetime work to spread their knowledge. It is necessary to work out relevant policies and rules in these aspects in order to guide these processes.

In order to make the technological market thrive and to facilitate the transfer of technology, we should promote the study of theory on techno-economics. The study of techno-economics should not only be directed at the analysis of some individual items, such as the study of the economic results of a research project or a technological transformation project in an enterprise; but we should also orient the study to the basic and overall factors of the economy, including the application of the law of value in the whole process of technology transfer, from the "production" to the "consumption" of technology, the forming and measure of the value of technology, and the role of technology transfer in economic development.

CSO: 4008/176

LOGISTICS REFORMS AT CAS SHANGHAI BRANCH

Beijing RENMIN RIBAO in Chinese 18 Oct 84 p 3

[Article by Xiao Guangren [5135 7070 2704]: "An Important Reform at the Shanghai Branch of the Chinese Academy of Sciences; Research Logistics Work Tried as Enterprises"]

[Text] The Shanghai branch of the CAS has in recent years been trying out an important reform. They have been gradually merging several closely-related subordinate logistics units, unifying their logistics work and putting into practice the management of these as enterprises. This is basically a revision of the long-time practice whereby each research unit conducted its own "mini society." This has improved service, and created the conditions for research logistics work to make a socialized transition.

The CAS Shanghai branch has 20 subordinate units. Each unit, large or small, had its own set of logistics organizations. These were often duplicates separated from each other by no more than a wall. This not only was a waste of manpower, materiel and financial resources, but was also inconvenient to manage, with very little work benefit. After researching the situation, branch leadership decided to implement a reform of the management system by merging the logistics work of adjacent research institutes and beginning to manage these as enterprises, so as to make logistics work "serving, beneficial, economical and reliable."

During the past year, the Shanghai branch of the CAS has implemented or is now implementing the following reforms:

1) In the vicinity of Yueyang Street, very near to the research institutes, they are preparing to establish a logistical service company, which will combine under one management the administrative and housekeeping services for several research institutes in the vicinity. As a first step they merged the 54 vehicles and 38 drivers of several units, forming them into a consolidated motor pool. The motor pool dispatches capable cadres, carrying out the methods of rewarding the industrious and penalizing the lazy, which has aroused the enthusiasm of everyone. After the merger, the vehicle utilization rate went up, and things which had been difficult to do before are now being accomplished readily. For example, the

Biochemistry Institute once needed the use of 13 vehicles within one hour; when the research institutes' support was so dispersed, there was no way that so many vehicles could be sent. In this instance, they were on their way as soon as the service company heard the order. Ordinarily, if one conforms to regulations and the necessary procedures, one can be sure of obtaining a vehicle at any time it is needed, even at night or on Sunday. The result of this reform has been to eliminate the uncertainties of converned responsible people in the institutes, and they have requested the branch academy to consolidate all housekeeping support work. The support service company is at present preparing for a consolidation of all maintenance and health work.

2) To set up and perfect regional compatibility of large-scale instrumentation, they are expertly managing communal laboratories. The research institutes in the Shanghai area altogether have 417 pieces of academy managed large-scale instruments, with a value of 50 million yuan. According to CAS deployment, the various institutes of the branch organizations practice communal use of instruments and equipment, and have established 42 communal laboratories, with a total of 88 academy managed instruments. Since implementation of special management communal use and quota checks, the equipment utilization rate has increased by 10 percent.

3) The branch academy is preparing a technological situation service company which will handle equipment supply. There are four service departments within the company. At the present time they are setting up a metal equipment service department on Yueyang Street, which will be responsible for supplying and acting as purchasing agent for ferrous and nonferrous materials. In addition, they will act to cut materials and metal shavings, and deliver goods to customers.

4) They have set up an engineering contract company to organize certain engineering projects for the research institutes. This will include doing all the work's early stages, such as design, construction, completion, acceptance check, etc.

The Shanghai branch of the CAS this year has carried out pilot projects on the several aforementioned areas, opened up the situation. With the experience gained, they plan in the coming year to put these into full practice.

12625
CSO: 4008/56

TECHNICAL SERVICES OF S&T PERSONNEL ENCOURAGED

Provincial Regulations

Shijiazhuang HEBEI RIBAO in Chinese 9 Apr 84 p 1

[Text] On 20 March, a leading science and technology group of the provincial government issued "Opinions on some questions in current after-work hours technical service of scientists and technicians." The main contents were as follows:

1. Hebei has few scientists and technicians and they are distributed quite unevenly. Consequently, provided that scientists and technicians complete their work, the pursuit of after-work hours service should be a major measure for a certain period from here on, giving impetus to technological progress and promoting the four modernizations. Leading cadres at all levels should take a positive attitude, energetically encourage it and give their warm encouragement and support.

2. As for past after-work hours technical service activities engaged in by scientists and technicians, on the one hand we should clearly distinguish correct and incorrect activities based on relevant national laws and policy regulations; and on the other, we should analyze and handle them historically and objectively. All advisory and service departments or commissioning units that sign after-work hours service contracts with scientists or technicians or their units should uphold the honor of the contract and continue to implement all the provisions stipulated in the contract; if the original provisions of the contract are not appropriate, they should be revised or rescinded through joint consultation by both parties, and no one side may revise or rescind without authorization; nor may they deny the legality of a signed contract because of organizational adjustments or personnel changes. All advisory and service departments that organize scientists and technicians to undertake after-work hours technical service work without securing the agreement of the unit to which the scientists and technicians belong, the department seeking service should explain the situation to the concerned units and bear the responsibility and the scientists and technicians should not be blamed. It is improper for commissioning units to directly hire scientists or technicians to undertake after-work hours service projects or for scientists or technicians to take the initiative in contracting an after-work hours service project without getting the agreement of the unit they belong to, and the commissioning unit

should bear the responsibility. The scientists and technicians should also explain the situation to the unit they belong to and also voluntarily make a self-criticism and the leadership of his unit should reinforce his ideological education, but absolutely not allow this to be used to punish the person.

3. We should view past remuneration of scientists and technicians for engaging in after-work hours technical service as legal income and should not treat it as improper income, and in principle, they should not have to turn it in to their unit. Apart from those scientists and technicians who sign contracts with the unit they belong to, if technical service remuneration is too great (meaning more than 1,000 yuan greater than the average per capita income) or if the technical service time is not completely after hours, or if he used equipment or materials, etc. from his own unit, he should hand in an appropriate part of the amount to his unit after both sides have discussed it. In the course of after-work hours service, it is discovered that some of the scientific or technical personnel's income was received in kind or the means of drawing money does not tally with the financial system, etc., the responsibility should be placed on the commissioning unit and should not be made the responsibility of the scientists and technicians, and even less seen as their "economic crime."

4. Those scientists and technicians who earned a certain remuneration in the past through engaging in after-work hours technical service, and who were treated unjustly or handled wrongly, such as being discriminated against, criticized or investigated, etc., should have the situation rectified by the various concerned units as quickly as possible, and these units should adopt appropriate methods to remove the influence of those acts and allow the scientists and technicians to rid themselves of this burden and to work boldly.

5. From now on, scientists and technicians who engage in after-work hours technical service should do so in an organized way and with leadership. Provided that they complete the scientific and technical tasks set out for them by upper levels and by their own units, various concerned units should actively organize scientists and technicians to carry out after hours technical service and also sign contracts that combine responsibilities, rights and benefits. Under most conditions, the consulting service department or the commissioning unit may not directly hire scientists and technicians to undertake after-work hours technical tasks without getting the agreement of the units to which the scientists and technicians belong; and the scientists and technicians should not undertake technical assignments on their own initiative without the agreement of their own units. If some units really have a crucial technical problem urgently requiring a solution, and they designate and hire some scientists or technicians to undertake it or give guidance after hours, and if the scientists or technicians agree and if they really have the spare strength to take it on, the unit to which the scientists or technicians belong should proceed from the overall situation and give their active support, and take the initiative themselves to discuss the matter and sign a contract with the commissioning unit. They may not use any pretext to refuse, obstruct or create difficulties.

6. Under certain historical conditions, technical service activities engaged in by scientists and technicians in their after-work hours are a kind of supplement to scientific and technical planning and management. Each area, department and unit should provide support and protection according to relevant national laws and policy stipulations, and should strengthen its ideological and political work in regard to the broad masses of staff and workers, overcome "seeing red" and smash the "big rice bowl" and egalitarian thought. At the same time, they must also teach scientists and technicians that they must guarantee completion of the scientific and technical tasks assigned by their own unit, and with these prerequisites, they may undertake after-work hours service activities; they should also encourage scientists and technicians to contribute to four modernization construction without thinking of remuneration and teach them to conscientiously follow the various national rules and regulations and cadre discipline.

7. After they receive this document, each area and department should carry out an overall investigation once on the circumstances of scientists and technicians engaging in after-work hours technical service work, and if they discover problems, study and solve them in good time.

Commentary On Support of Technical Service

Shijiazhuang HEBEI RIBAO in Chinese 9 Apr 84 p 1

[Text] With the development of economic construction and reform of the scientific and technological system, some scientists and technicians in Hebei, with the precondition that they have completed their work, are actively engaging in after-work hours technical service in order to promote the progress of production and technology and have played a definite role and made beneficial contributions, particularly in transforming technology in small and medium-scale enterprises and in raising the technological level of agricultural production. The after hours technical service activities engaged in by scientists and technicians should receive encouragement and praise. However, some have been called "not engaged in proper work," or "pursuing money;" some been implicated in "economic crimes," brought on trial, investigated and dealt with; party members of some trial units in party rectification have not been able to register because of this matter. This is a new situation and new problem that has appeared in the course of implementing the policy for intellectual elements. Seen from an understanding of the reprimand materials regarding some scientists and technicians and from the investigation of some units, in addition to an unclear understanding of the policy limits of "economic crimes" and "reasonable remuneration," these problems have appeared because neither "left" ideological influence nor the tendency to look down on intelligence and discriminate against intellectuals have still not been eliminated from the minds of some leading comrades, and because these leaders are slow in responding to the implementation of the party's intellectual policy and their thinking is not sufficiently liberated. A leading science and technology group of the provincial government issued "Opinions on certain questions in current after-work hours technical service work of science and technical personnel," and each area, each department and each unit should conscientiously implement it, and correctly deal with the questions of the

remuneration obtained by scientists and technicians for engaging in technical service in their spare time and other questions.

We must see that the thorough implementation of the guiding principle for developing science and technology depends on giving full play to qualified scientists and technicians, and that in welcoming the challenge of the "new technological revolution," we must also strengthen the development of intelligent sources. Consequently, the continued implementation of the party's intellectual policy is still a major task. All levels of leading comrades in the party and government should have a fervent sense of responsibility and sense of urgency in regard to this, in order to create a social environment and general mood of respect for intelligence and respect for human talent. They should encourage scientists and technicians to give full play to their surplus enthusiasm and latent abilities and to be bold in making more contributions to the four modernization construction.

12452
CSO: 4008/277

MAKING FULL USE OF S&T PERSONNEL RETURNING FROM ABROAD URGED

Beijing GUANGMING RIBAO in Chinese 29 Aug 84 p 1

[Editorial by staff commentator: "Fully Utilize the Scientific and Technical Personnel Returning From Advanced Study Abroad"]

[Text] In the past several years, China has sent considerable numbers of scientific and technical personnel abroad for advanced study; nearly 10,000 of these have completed their studies and returned home. Among these are many who have mastered the advanced foreign science and technology of the 1970's and 1980's, and strengthened the ability of their fields to use advanced S&T methods to gain research achievements. These people are in their prime, in the period of their maximum professional competence. It is hoped that some of these comrades will replace the older generation of scientists at the forefront of S&T. We must make the fullest use of them: this will develop China's S&T, speed up the economic construction China so urgently needs, and is in addition an important part of the present policy toward intellectuals.

At present, this particular batch of S&T talent is the abundant creative strength of our S&T community, and should be highly valued and received the fullest attention. First of all, they should be rationally arranged and employed. The research projects in which they were engaged while overseas should be basically linked up with the work they did before going abroad. There should be support and encouragement for them to extend the frontiers of their fields, in order to attain high quality results as soon as possible. After their return from abroad, their professional directions can be adjusted slightly in light of China's specific realities and conditions, merging each person's aspirations and characteristics and rationally arranging his or her work. Next, we should continue to train and improve them, and those comrades among them who combine good political character with a high degree of professionalism, and have organizational and administrative ability, should in time be selected to move up to leadership posts at various levels. Again, those who owing to their going abroad did not go through the evaluation of technical titles, should have their technical titles and work rectified according to the national regulations; this should be resolved in time.

The research results achieved overseas by these returned S&T personnel will be and important component of China's research. Of the research projects they were engaged in abroad, some are needed to create definite work conditions in China, and must be linked up with research work in order to benefit national economic construction. Some research projects also are to be done in a race against time, in international competition. For this reason, the concerned units which sent these people abroad should have a firm grasp of some important and worthwhile projects which are urgently needed. They should bring every positive factor into play, fully tapping the latent power that is now available, creating the necessary work conditions for this talent, including such things as laboratories, instrumentation and equipment, materials, capable assistants, etc., in order to ensure that their research work can go forward effectively.

12625
CSO: 4008/56

HUNAN BANKS FUND S&T PROJECTS

Beijing RENMIN RIBAO in Chinese 19 Oct 84 p 3

[Article by Wu Xinghua [0702 5281 5478]: "Hunan People's Banks at Various Levels Positive About Granting S&T Funds"]

[Text] The Hunan People's Banks at various levels have acted positively in granting S&T funds to support research units and enterprises in developing new technology and disseminating new results. According to the banks' statistics for the entire province, a grand total of over 25 million yuan was granted for S&T this year from January to September. This has resulted in new production worth 60 million yuan, and additional new tax revenues of more than 26 million yuan.

In recent years, a significant number of projects could not be carried out, owing to some Hunan research units and enterprises lacking the necessary funds. In addition, many research findings and imported new technology could not be trial-produced and put into production. Based on this new situation, the People's Banks in such places as Xiangtan and Zhuzhou made a bold effort to carry out the granting of research funds. The Xiangtan branch People's Bank last year granted 503,800 yuan which was used for trial manufacture and production of 11 projects. At the end of the year, these projects were completely successful, and some obtained obvious economic benefits that year after batch production. The Provincial People's Bank gave its prompt approval to the Xiangtan branch's undertaking, and issued clear-cut and explicit stipulations regarding the extension of research grants.

The Hunan People's Banks at various levels, while taking a positive initiative in granting funds for scientific research, are at the same time acting cautiously. Before any funding, they carry out in-depth S&T and market surveys, with the aim of determining and proposed projects' technological advancement levels, maturity and suitability, as well as their economic effectiveness, rationality and feasibility. In other words, if full credit is extended to support S&T research in progress, what are the potential high level results?

The Zhuzhou Electronic Research Institute began design work on the CMC-80 microcomputer at the end of 1981, and at that time asked the People's Bank for funding support. When the People's Bank received the application,

it carried out a technological survey, which resulted in the bank providing 460,000 yuan in development support. After development was completed in July 1982, the Electronics Institute requested additional funding. The Zhuzhou branch bank sent experts to take part in classes on microcomputer use conducted by the Electronics Institute, made a detailed appraisal of the data from this accomplishment,and carried out a forecast of market trends and the profit situation. Recognizing the development prospects for this microcomputer, from 1982 to 1984 they extended a total of 1,390,000 yuan in support of this microcomputer. In the past 2 years, the Zhuzhou Electronics Institute has produced a total of 2,118 CMC-80 microcomputers, realizing a profit of 1,769,000 yuan.

The Hunan People's Banks at various levels, with fundamental economic and technical justification, have dared to break with convention and extend grants to projects which are technologically advanced and capable of repaying the funding. The Hunan Electronic Computer Service Company was a newly established unit, with only 300,000 yuan in funds. In May of this year, the company, with State Economic Commission approval, decided to import a system which consisted of some six microcomputers operating in network. They had targeted the foreign exchange, but lacked the matching funds in Renminbi, so requested a loan from the bank. According to convention, a unit seeking such funds must have a certain amount of funds on hand before obtaining permission to borrow additional funding. After looking into the situation, the Changsha branch recognized that importing the microcomputer system and its matching parts would open up the Hunan computer industry and would be of major significance in promoting the progress of science and technology. Therefore, the bank decided to make an exception and gave support in the form of a grant of 6,780,000 yuan.

12625
CSO: 4008/56

RESEARCH INSTITUTES NEED MORE AUTHORITY

Beijing GUANGMING RIBAO in Chinese 8 Apr 84 p 1

[Text] In recent years the Shanghai Machinery Manufacturing Technology Research Institute, the Laser Technology Research Institute, the Light Industry Research Institute, the Textile Science Research Institute, the Architectural Science Research Institute and the Crop Research Institute of the Academy of Agricultural Science, as the experimental units for restructuring Shanghai's science and technology system, have achieved considerable accomplishments, but they have also met one obstacle after the other, and at present it is difficult to push their restructuring any further. The discussion that this paper began on the restructuring of the science and technology system aroused the deep interest of these experimental units. Several days ago, reporters from this paper in Shanghai invited the concerned responsible comrades of these units to an informal discussion, and at the meeting they urgently requested the further loosening of policies to stimulate science and technology work.

They reviewed the course of restructuring during the past year and unanimously believe: restructuring has brought vitality and restructuring is where their hopes lie. By trying out the economic contract system for scientific research and the responsibility system for science and technology, these units have mobilized the enthusiasm of their science and technology personnel. They realize from actual experience in the past year that changing the system of drawing "all funds from the state," and a change from receiving operating expenses to a renumerative contract system plus expenses for certain special items have brought a major directional restructuring to the science and technology system and that this restructuring has spurred on the integration of science and technology work and economic construction, making scientific research units take responsibility for their own development and no longer "eat from the same big pot" while resting on the state. To adapt to this restructuring, these six research organizations carried out strict economic accounting, and turned from pure "research" of the past to a "research and business model," that is, they learned how to "do business" and paid attention to economic results. Of course, research institutes in the end are different from plants and enterprises and they also actively shoulder the responsibility for certain projects that have great technological significance or that serve the interests of society but which bring in few fees or even lose money. Therefore, they particularly pointed out that when financial departments formulate relevant tax revenue and price policies, they should not equate scientific research units with plants and enterprises.

They feel that at present the largest problem blocking restructuring is the fact that research institutes lack autonomy. They have authority neither over personnel nor over finances. A comrade from Shanghai's Architectural Science Institute reported that the institute director does not even have the authority to buy a package of tea. They said that the current restructuring involved piecemeal restructuring in what was in the first place a quite unsuitable container. In the area of awards, the Industrial Technology Institute is limited to disbursing the equivalent of an average three months' wages as bonus and the five other institutes are limited to two and a half months', which is generally about a little over a half month higher than non-experimental units. A comrade from the Shanghai Light Industry Institute said that they fluctuate in the institute according to that award ceiling and in the first year it played a stimulating role. But this year it clearly did not work. The higher people's enthusiasm, the lower the award and so egalitarianism appeared at a new level. Science and technology personnel said figuratively that "a chicken in a cage, with just a little bit of chicken feed, will finish it all off with just a few pecks." A comrade from the Shanghai Laser Institute said that we should permit research institutes to hold back a certain proportion of the contract income and distribute it to comrades who have made fairly large contributions according to the principle of to each according to his work. At present, Shanghai has still not broken through the fetters of certain conventions and there is no way that the principle of to each according to his work can be lived up to. If we do not solve this problem then the renumerative contract system for scientific research will be difficult to implement, and even if it is implemented there will be no way to maintain it for very long. Therefore, only if policies are relaxed and more financial and personnel authority are given to research institutes so as to allow science and technology work to have external force and internal motivation will they be able to dynamically come to life!

A comrade from the political research office of the Shanghai Municipal Science Committee also attended the informal meeting. He said that the Shanghai branch research institutes could be said to be the earliest, in 1979, to adopt the scientific research contract system and actual experience has shown that it promotes science and technological development.

The restructuring experiments of the past year at the sixth unit of the Shanghai Industrial Technology Institute were also successful. However the desired spread of restructuring has not gone through. At present the methods of Zhuzhou's Electronics Institute are not possible in Shanghai. Although Shanghai took the earliest steps and took the lead in restructuring the science and technology system, it is now dragging its feet and falling behind. What is the problem? It is primarily because personnel and the mobility of human talent have been constricted by the currently implemented personnel and wage systems; financial authority is inseparable from the restructuring of the financial system and the financial affairs system. It seems that if we do not further relax policies and if we do not carry out simultaneous restructuring of the personnel and wage systems, then it will be very difficult for lower levels to free themselves.

12452
CSO: 4008/277

ECONOMIC MANAGEMENT IN SCIENTIFIC RESEARCH INSTITUTES DISCUSSED

Beijing KEYAN GUANLI [SCIENTIFIC RESEARCH MANAGEMENT] in Chinese No 4, 1984 pp 73-76

[Article by Du Shunxing [2629 7311 5281], Management Cadres Institute, Chinese Academy of Sciences]

[Text] In modern society, the development of science and technology has played an ever more important role in the development of the national economy. Therefore, improving the economic benefits of scientific and technological activities and accelerating the developmental speed of the national economy are economic problems to be studied by technologists and economists. The following are my opinions on the economic management of scientific research units.

I. Set out from Macroscopic Economic Management and Restructure the Scientific Research Fund.

The most important tasks of our developing scientific work under socialism are to serve economic construction and serve the consolidation of national defense and the continuous improvement of our people's material and cultural life. As was pointed out lately by the secretary of the Party Central Committee, the direction and tasks of the Chinese Academy of Sciences include: vigorously strengthening applied research, enthusiastically but selectively participating in developmental work and continuing to stress basic research. These are the starting points and goals of our country's scientific research.

The development of a socialist economy requires the realization of a planned and proportionate development law. Scientific work is an essential part of the national economy and therefore must also follow this law. However, the scale and level of scientific research must be suited to economic development and maintained at an appropriate level. This is because scientific research activities consume fixed resources of manpower, materials and funds. When redistributing the national income, the proportion which can be put into scientific research activities depend on the level of economic development. With the gradual expansion in the scope of scientific research and the increases in the difficulty of research work, scientific research activities will require more and more funds.

This is why scientific research activities face the obstacle of limited financial resources at a certain stage of development. In developing countries, this is a very prominent problem. For example, the development of a high-energy accelerator in our country has to be abandoned because its high demand for funds and technology is not suited to redistribution in the current national economy. This is why we have to reconstruct our macroscopic economic management in order to develop science and technology further. The current financial system for scientific research is taken care of by the state allocation system. It does not have much of a function in managing of scientific research, much less a function in balancing the economy through managing funds and promoting the development of scientific research.

The financial resources of the Soviet Union's scientific research institutes were dependent on the state budget before 1961. With the continuous development in the methods of economic management, however, it became objectively necessary that they seek a financial structure which would promote the integration of scientific research institutes with production. In 1961, "Decisions Relating to the Transformation of the Economic Accounting System in Scientific Research Units and Design Institutes" was issued by the Soviet Union's Council of Ministers. Two channels for financial resources opened up for the Soviet Union's scientific research institutes: state budget allocations and contract funds. Besides the portion guaranteed by the state, research institutes have to depend on themselves to sign economic agreements with enterprises to obtain the rest of their funds. The United States, Japan, France, West Germany, etc. have been practicing multiple-source scientific research funding for many years. For example, the proportion of sources of the United States' scientific research funds in 1982 was: the federal government, 47.6 percent; industrial sectors, 48.8 percent; universities, 2 percent; and non-profit organizations, 1.6 percent. In Japan, the porportion in 1980 was: national and local governments, 28 percent and non-government sources, 72 percent. In West Germany, the proportion in 1978 was: government, 46 percent; industrial sectors, 51 percent; non-profit research organizations, 1.2 percent; and foreign sources, 1.8 percent.

Currently, scientific and technological consultation and compensated transference of scientific research results and other measures taken in our country's development of technology and the popularization and utilization of scientific research results are our first steps in replacing the unitary state-allocated system with multiple-source scientific research funds and the reform of funds management. However, the award fund system and other rules and regulations such as retention in proportion with income, etc. which follow the reconstruction of fund management are superficially supporting the development of scientific research and to a degree actually conditioning its development. We should reevaluate them. According to the spirit of Premier Zhao Ziyang's government work report given on behalf of the State Council at the Second Plenary Session of the Sixth National People's Congress, the reconstruction of the scientific research system is imperative and the current management system of scientific research funds needs to be thoroughly reformed. Scientific research units

which are engaged in technological development and its popularization and utilization can practice a compensated contract system and be economically independent. Units which are engaged in basic research and partially applied research can practice the differential subsidy system. As for scientific research projects which demand intensive funding as well as technology, the foundation system which, through inter-professional evaluation, selects the best projects to support should be adopted. Responsible higher units should, through variations in the proportion of the distribution of scientific research funds and subsidies, adjust the proportion of their subordinate units' various research activities, thereby achieving the adjustment of the key points of scientific research work and the goal of setting the direction for development. Scientific research units should practice the director responsibility system and carry out personnel and financial independence. Research units should bring into full play their advantages, according to their specific professional specialties and their current situation, and develop in a planned and selective way technological development work, thereby practicing comprehensively the compensated transference system of scientific research achievements. Accomplished scientists of qualified scientific research units should be made presidents, managers and entrepreneurs and should lead the units into an independent or semi-independent economy. Practice proves that the use of the leverage function of funds in the macroscopic management of scientific research will promote the earlier development of scientific research work and the integration of scientific research with production. Therefore, reforming the structure of the financial resources for scientific research funds and the budget allocation system is significant in strengthening the macroscopic economic management of scientific research.

II. Reform Current Fund Management System from Microeconomic Management

The problems which we have in the management of scientific research funds are mainly reflected in two ways. One is that there is little money invested in scientific research, and the state does not allocate an adequage budget; the other is that the money invested does not play its proper role. The former is a macroscopic problem of strategies while the latter is a microcosmic problem of results. The emphasis here will be on the microcosmic problem of the management of scientific research funds.

1. Economic Accounting Should Be Used in Scientific Research Funds

Socialist economic accounting is the scientific theory based on the summaries of Lenin, the proletarian revolutionary teacher, of the practices and experiments of socialist economic management. He believed that under the condition of a publicly owned materials system, only when enterprises are made comparatively independent economic accounting units, can the principle of democratic centralism be carried out thoroughly in economic management and the advantages of the relation of socialist production realized.

Economic accounting is the fundamental principle for organizing socialized mass production and handling the production and management activities.

It is also the basic method for the planned and selective utilization of economic leverage to administer enterprises and businesses as well as an important measure for improving economic benefits. The basic goal of economic accounting is to solve the problem of increasing the economic benefits of enterprises and businesses which are engaged in scientific research and scientific research production.

Over a long period, many scientific research units, due to the influence of the "leftist" ideology, did not pay attention to costs, depreciation, profits or losses while managing their scientific research funds. Instead of depending on themselves for expansion and research, they look completely to the state for investment funds and for allocations of the budget. They do not pay anything for using the facilities, and do not have any economic responsibilities when using them. Many practices have proved that this kind of supply system has many disadvantages. For example, research units compete for investments, facilities and equipment and try to be "big and complete" or "small and complete"; investment is used improperly, the utilization rate of equipment is very low; the turnover rate of circulating capital is very slow; a lot of fixed assets lie idle and a lot of material is overstocked, thus resulting in serious waste. We should demand that scientific research units allocate their limited scientific research funds properly, use them effectively and be sure not to waste any. To reach this goal, we have to do a good job of economic accounting. Only through this can we have control over authentic technological and economic data, achieve the first-rate management of science and the economy, make accurate decisions and achieve sound managerial results and economic benefits.

2. Practice Compensated Contract System Externally and Task Contract System Internally

In order to mobilize the enthusiasm and creativity of scientific research units and scientists and technologists, and enable scientific research work to play its role in the construction of the four modernizations, it is essential for us to strengthen our management of scientific research work and reform our current scientific research management system. To practice the compensated contract system externally and the task contract system internally are an important beginning in the reform of the current system. The Zhuzhou City Electronics Institute has set an example for us by overcoming many disadvantages which have existed among scientific research units for a long time.

A very poor practice which has existed in our scientific research departments for a long time is the practice whereby the state takes full charge of arranging research funds and personnel. Scientific research units do not have any technological or economic responsibilities. The egalitarian "iron rice bowls" and "big rice canteens" can be seen anywhere, particularly among scientific research units. Problems such as indefinite tasks, unevaluated results, insufficient popularization, unaccounted expenditures and unassessed personnel are not uncommon in many scientific research units. As a consequence, inside a research unit and among different units there is

no difference between whether there are results or not, whether the level is high or low, whether the achievement is utilized or not and whether the benefit is large or small. As another consequence, there is no impetus from within the research units and no pressure from without. The practice of a compensated contract system promotes the popularization of results and the development of technology. It is advantageous to the close integration of technology with the economy and makes scientific research work suited to economic construction.

In the internal-task contract system, funds are allocated directly to the person in charge and the task group. The research institutes deduct a percentage from the funds. In this way, economic benefits are directly linked up with individual benefits and the responsibilities, powers and benefits are closely integrated. The creators of knowledge should be respected and the reward for the labor of scientists and technologists should be higher than that for the labor of others in the institute. Only thus can we mobilize the enthusiasm of the scientific research units and scientists and technologists can move the development of the task contract system in a healthy direction.

3. Improve Efficiency of Scientific Research Organization

The organization of our present scientific research units is generally still of the 1950-60's type, with organizational structures overlapping each other, more staff than work, people arguing back and forth over their work and too much idle talent. Through the transference of scientific research results under the compensated contract system, task contract system and free organization of task groups, a highly efficient system has appeared. The original multi-level organization of scientific research units has been replaced by a three-level one which includes a director, a function department (section) and task group. Of the three levels, the function department (section) practices its own functional work in accordance with its administrative subordination; the task group is led directly by the director. The advantage of this system is that the leader, by going down to the grassroots units, can control the firsthand material. The decrease in the number of intermediate links makes the guidance and direction of scientific research easier. The grassroots units can have their problems solved immediately when they have any. When organizations are made to become highly efficient, the socialist distribution principle of a greater reward for more work should be carried out thoroughly among all the scientists and technologists. By giving job stipends, position stipends and technical stipends, and retaining scientific research achievements, etc., some of the scientists and technologists can be made rich, thereby largely increasing the efficiency of scientific research work. With the practice of highly efficient scientific research organizations, the number of scientific, technological and administrative personnel will be reduced. These people can be organized as mobile talent or be sent to advanced study and training or can participate in technological developmental work so as to make the best possible use of these people and their talent.

4. Smash Department and Local Ownership System and Move Toward Socialization

(1) Develop the Potentialities of Equipment and Organize Sharing of Large-size Equipment. Quite a large number of advanced equipment which our scientific research units have are imported and are very expensive. The budget allocation for this makes up two-thirds of the scientific research units' total expenses. This is a tremendous figure. Therefore, good management of the equipment budget is essential to the good management of the scientific research budget. In order to manage the equipment budget well, close attention must be paid to the purchase and use of large-size equipment. In order to cut down expenses and increase the utilization of equipment, appropriate sharing of some frequently used equipment can be adopted. As for precise, complicated, rare and expensive pieces of equipment, a public laboratory (or laboratory center) should be set up for them. In the laboratory, centralized management should be adopted and the pieces of equipment taken care of by specialists and used in a uniform way. Research units with conditions should break the departmental and local restrictions and should be geared to the society by practicing the compensated utilization of equipment. By so doing, they not only can increase the utilization ratio of the equipment but can also increase their income.

(2) Cut down Administrative Expenses and Gradually Socialize Backup Work. Currently, the ratio of scientific research personnel, technical personnel and administrative personnel in the scientific research units is approximately 4:3:3. In order to reduce non-productive expenses and strengthen front-line scientific research personnel, we should decrease the ratio of auxiliary and administrative personnel and gradually commercialize and socialize backup work. Besides the administrative, party political, personnel, scientific research management and financial and accounting departments, a labor service company should be established to include general affairs, condition (of equipment), experimental factories, maintenance, drivers groups, child-care centers, dining rooms and other welfare departments and should practice independent accounting. To make it more secure, we should have two signs over one troop of people at the very beginning and be a general-affairs and requirements office (sections), etc. internally and a labor service company externally. When we have gained experience in the organization of the company, the arrangement of cadres and the management of business, we should make the company an independent enterprise unit.

5. Budgets

The budget is an income and expenditure plan formulated for a budgetary period (generally calculated by the year). It is based on the scientific research tasks assigned by the superior departments and on the scientific research units' own plans and the summaries of previous experiences in the development of scientific research work plus the full exploration of every potentiality. It is the coordination and the comprehensive balancing of different tasks. It is the scientific research units' achievements in technological and economic activities expressed in currency and is one of

the important bases for judging the research units' management of their economy.

The major function of the budget is to sum up, in the form of value, the scientific research organizations' consumption of manpower, materials and financial resources as well as their sources of income within a certain period and to predict each unit's scientific research income and expenditures within a budgetary period, thereby providing the staff and workers with definite and practical income and expenditure figures and bringing forward a direction for the continuous increase in economic results and improvement in management and administration.

A scientific research unit not only must work out its expenditure plan but must also, on the basis of innovation and exploration, work out its revenue plan. Neither of them should be overemphasized at the expense of the other.

Revenues include: (1) state allocations; (2) income from cooperation with external organizations; (3) income from intermediate test production; (4) income from the popularization of scientific research achievements; (5) income from scientific research products sold; (6) income from technical services; (7) income from personnel training for other organizations; and (8) others.

The total of the above items estimated by year is the budgetary income.

Expenses include: (1) research and operating expenses; (2) expenses for cooperation with external organizations; (3) expenses for special equipment and materials; (4) expenses for intermediate tests; (5) expenses for capital construction of technical measures; (6) expenses for technicians' insurance; (7) expenses for fuel and power; (8) expenses for scientific and technological education; (9) expenses for books and materials; (10) expenses for management and administration; and (11) expenses for the wages and welfare benefits of the entire staff and the workers.

All the above items estimated for the year are budgetary expenses.

Seeing that scientific research itself has many characteristics, it is necessary that when working on the budget we start from reality and use scientific methods as much as possible to increase the accuracy of the budget. To achieve this, we must pay attention to the following items:

(1) Correlation or quota methods are generally inappropriate for research tasks in different fields and are on a different scale due to their lack of constant qualities. Instead, scientific methods should be used to calculate the budgets these tasks need. For purely technical works with certain repetitions or correlations, however, the quota method should be adopted to calculate the budgets they need.

(2) We should have the interest of the whole in mind and be practical and realistic. We should never start out from selfish departmentalism and

carry out repetitious development, purchasing, importation and capital construction blindly and expand our own budgets willfully.

(3) We should bring into full play the leverage function of the economy and practice the compensated use of fixed assets, consumable materials and low-value consumer goods, thereby keeping a good economic account for the suppliers and purchasers and achieving a good budgetary plan for internal use.

(4) When drawing up a budget, attention must be paid to the continuity of the previous and later periods. The balance of the previous period and the expenses needed for unfinished scientific research projects to be carried over to the next year should both be included and calculated so as to reflect comprehensively the realities of the period's budget.

(5) In order to have a timely understanding of the use of the budget, there should be an adjustment of the budget according to each task group's situation at the end of the third quarter and the beginning of the fourth quarter of each year. By so doing, the budget can be managed on a more solid and dependable basis.

12369
CSO: 4008/89

RESULTS OF PSYCHOLOGICAL MEASUREMENT OF S&T WORKERS

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF SCIENCE AND TECHNOLOGY] in Chinese No 9, 1984 pp 30-31

[Article by Wang Jisheng [3769 2817 4141] of the Institute of Psychology, Chinese Academy of Sciences: "Metrological Study of Scientific Psychology"]

[Text] For the last 2 years I have used the techniques of self evaluation and psychological investigation to conduct a metrological study on the scientific phychologies of scientific creativity and scientific research management of over 700 Chinese science and technology workers. In this study, 61,000 pieces of information were collected and through computer processing 32,000 statistics were derived. Each statistic contained such items as numerical average, standard deviation, t test, f test, coefficient and categorical analysis.

The results of each part of the research are briefly outlined below.

The first part consists of the research on intellectual and nonintellectual factors affecting China's science and technology workers.

I. A quantitative study on the level of intellectual development of China's science and technology workers showed the following:

A. The relative coefficient of the intelligence levels between China's S&T workers young and middle aged, the young and older workers, and the middle aged and older workers in the statistical study all attained a remarkable level and were closely related.

B. In comparing the level of intellectual development among China's S&T workers young, middle aged, and older workers, the middle aged workers were considered to have the highest level of intelligence. The young workers had the highest level in memorization capability, speed of memorization, memorization accuracy and memory retention. The middle aged workers had the highest level in observation sensitivity, accuracy in observation, analytical ability, combining of thoughts, thought comparison, ability for abstract thought, thought summation, scope of thought, quick thinking, thinking things out for oneself, creative thinking, richness of imagination, intensity of imagination, creative imagination, being conscious of new ideas,

creativity and capacity for work. The older workers had the highest level for depth of thought.

I believe that development of the intellectual resources of middle aged S&T workers and giving full play to their intelligence are important conditions for China's science and technology to grow and flourish.

C. Members of the departments and committees under the Chinese Academy of Sciences have a higher level of observation capacity, memorization, thinking, imagination and work capability than ordinary S&T personnel.

D. The intelligence level at various times for male and female S&T workers was for the most part identical.

II. A quantitative study of the structure of S&T workers creativity showed the following:

Research revealed that in the psychological structure of creativity the related coefficient levels of memory retention, quickness of thought, ability to think things out for oneself, creative thinking, creative imagination, the composition of innovative thought, and creative ability had all attained a remarkable level.

I believe that being aware of new ideas is the starting point for creative activity, that quickness of thought is the foundation for the speed and scope of creative activity, that the ability to think things out for oneself is the foundation for originality in creative activity and that the core of creative ability is creative thought and creative imagination.

III. A quantitative study on the creative thinking of China's S&T workers showed the following:

A. Creative thought is closely related to the levels of ability in the following five thought processes: analytical ability, combining of thoughts, thought comparison, abstract thought, and summation of thoughts. The level of creative thought and the level of the five thought processes have a significant effect on each other.

B. The level of creative thought is closely related to the levels of the following four thought qualities: scope of thought, depth of thought, quickness of thought, and independent thought. The level of creative thought and the level of these four thought qualities have a significant effect on each other.

C. The level of creative thought is very closely related to the following intellectual feelings: a craving for knowledge, curiosity, suspicion, and self confidence. The level of creative thought and that of these feelings also have a significant influence on each other.

D. Creative thought has a close relation to the levels of the following: calm mood, being able to control your feelings, enthusiasm for scientific

research, persistence in accomplishing a task, self control, resolute willpower, devoted scientific spirit, and having a spirit of seeking the truth. The level of creative thought and these also have a significant influence on each other.

IV. A qualitative study on the mental health of China's S&T workers showed the following:

A. The young, middle aged and older S&T workers level of mental health and physical health were at remarkable levels, and showed a direct relationship exists between mental and physical health.

B. The significant levels attained in the coefficients of mental health between young and middle aged workers, young and older workers, and middle aged and older workers were very close in relation to each other.

C. The significant levels attained in the coefficients between the mental health and intellectual development of young, middle aged and older S&T workers showed a direct relationship.

I believe that raising the level of mental health in S&T workers is a strategically significant method for meeting the new technological revolution.

The second part consists of a quantitative study on creative psychology in science and technology.

I. A quantitative study on the effect of 25 intellectual factors in S&T creativity showed the following:

A. The 25 intellectual factors have a definite effect on basic research in natural science, applied and developmental research, social science research, and S&T management research, but the degree of effect is different. Of the 25 factors, the factor with the greatest effect on all of the five types of research was the capacity for thought.

B. There was a certain degree of difference in the effect each intellectual factor had on the five types of scientific research.

C. The factors of sex and age had a small influence on the degree the 25 intellectual factors affected the five types of research.

II. A quantitative study on the effect of 25 nonintellectual factors on S&T workers showed the following:

A. The 25 nonintellectual factors had a definite effect on the five types of research, but the degree of effect for each was different. Diligence, interest, sense of responsibility, initiative, and a thirst for knowledge were at the top of the list in effect on the five types of research.

B. There was a certain degree of difference in the effect each nonintellectual factor had on the five types of research.

C. The factors of sex and age had a small effect on the degree the 25 nonintellectual factors affected the five types of research.

III. A quantitative study on the effect of 25 creative psychological related factors in science and technology creativity showed the following:

A. The 25 factors related to creative psychology all had a definite effect on the five types of research, but the degree was different. The factor with the largest effect on the five types of research was the ability to study independently; the factor with the smallest effect was dreams.

B. There was a certain degree of difference in the effect each factor had on the five types of research. For example, taking the computations of the five separately, the effect of organizational ability on the five types of research had the following respective amounts: 3.5, 2.9, 2.7, 3.4, and 3.9.

C. The factors of sex and age had a small effect on the degree the 25 creative psychological related factors affected the five types of research.

IV. A quantitative study on the effect of 25 factors of social psychology on science and technology creativity showed the following:

A. The 25 factors of social psychology all had a definite effect on the five types of research, but the degree of effect was different. Patriotism was fifth in its effect on basic research in natural science; it was first place in its effect on the other four types of research.

B. There was a certain degree of difference in the effect each factor had on the five types of research.

C. The factors of sex and age had a small influence on the degree the 25 factors related to social psychology affected the five types of research.

The third part consists of a quantitative study on science and technology management psychology.

A quantitative study was conducted on S&T personnel's psychological problems of growth, training and employment, their needs and motivations, exchange of knowledge, their aggregate psychology, and the problems of their professional positions. For example, of the 60 factors affecting the management of growth of talented personnel in S&T that I drafted, all the factors had either a large or small effect on the three types of S&T management of the growth of talented personnel. The research showed the 10 main factors affecting the S&T management of the growth of talented personnel are the sense of responsibility, dedication, thirst for knowledge, diligence, education, patriotism, determination, tenacity, and collectivism. The majority of the factors had a similar effect on the three types of management.

I propose using the point calculation method to evalute S&T personnel for promotion, which takes the S&T personnel's achievements, awards, work, and economic and social results to obtain a standard point score for

evaluation along with their records in personnel relationships, the S&T personnel research results and other things that are constantly added to their records. When the S&T personnel obtain a certain position point criteria and pass the examination they are then promoted.

12704
CSO: 4008/87

BRIEFS

XINJIANG SCIENTIFIC, TECHNOLOGICAL DEVELOPMENT--The Xinjiang network of scientific and technological development, exchanges, and cooperation was set up in Urumqi today. The network will organize and coordinate scientific and technological development and exchanges between departments and places and will provide scientific and technological service to factories, mines, enterprises, township and town enterprises, specialized households, scientific research units, institutes of higher education, and other organizations in society. More over, the network will provide information on scientific and technological development and exchanges and statistics on economic results to departments concerned of the Regional People's Government. [Summary] [Urumqi Xinjiang Regional Service in Mandarin 1300 GMT 25 Dec 84 HK]

XINJIANG FORMS SCIENTIFIC GROUP--In order to coordinate the forces of the Chinese Academy of Sciences and the regional scientific research departments, and to make science and technology play a more important part in developing and building the region, the Regional People's Government and the Chinese Academy of Sciences have recently formed a joint leading group in scientific research work for developing Xinjiang. The group consists of our members and is led by Song Hanliang, vice chairman of the region, while the deputy head of the group is Sun Honglie. Under the group is a joint office, which is responsible for executing the group's decisions; and coordinating with, formulating plans for, as well as supervising the scientific research organization. [Summary] [Urumqi Xinjiang Regional Service in Mandarin 1300 GMT 9 Dec 84 HK]

SHANGHAI PATENT OFFICE INAUGURATED--Shanghai, 27 Nov (XINHUA)--The Shanghai Patent Agency Office was inaugurated today. It is an agent, designated by the State Council, for handling patent affairs which concern foreign nationals. The office has also been approved by the State Patent Bureau and the Shanghai Municipal People's Government for handling domestic patent affairs. It renders services regarding application of patents, patent consultancy and technology transfer, and acts as an advocate in patent litigations, or as a permanent patent consultant. [He Zujia] [Text] [Beijing XINHUA Domestic Service in Chinese 1558 GMT 27 Nov 84 OW]

SHANGHAI RESEARCH CENTER--The Shanghai Engineering Science Research Center was set up on 3 January. Among those present at the inaugural to extend congratulations were Mayor Wang Daohan, Huang Ju, a member of the Standing Committee of the Shanghai Municipal CPC Committee, and Vice Mayor Li Zhaoji. The center is a think tank for Shanghai's development. Minister of Machine Building Industry Zhou Jiannan and Minister of Electronics Industry Jiang Zemin serve as honorary presidents of the center, while (Xiao Che) is the president. [Text] [Shanghai City Service in Mandarin 2300 GMT 3 Jan 85 OW]

COMPUTERS IN CHINA--As of early 1985, there will be 4,000 large computers and 30,000 microcomputers in operation in China. Approximately 100,000 people are currently working on the research, development and production of computers or deal with the application of computers and training of skilled workers. According to press reports, increased attention is to be paid to computer technology in the Seventh Five-Year Plan, beginning in 1986. Particular attention will be given to the development of text processing systems which can process the Chinese characters electronically. [Text] [East Berlin BAUERN-ECHO in German 21 Dec 84 p 6]

CSO: 2302/54

DEVELOPMENT, ACHIEVEMENTS IN CHINA'S CARTOGRAPHY WORK

Beijing CEHUI TONGBAO /GEODESY AND CARTOGRAPHY BULLETIN/ in Chinese No 4, 25 Aug 84 pp 1-6

/Article by the Editorial Department of DANGDAI ZHONGGUO CEHUI SHIYE /CONTEMPORARY CHINESE CARTOGRAPHY/ in the State Cartography Bureau Political Research Office: "Developments and Achievements in Cartography in New China"/

/Text/ Cartography is an important measure for understanding nature and studying society. Cartographic work is directly related to scientific construction planning, project quality and the achievement of results in the expected time period. Cartography is a line of work that is fundamental and at the leading edge of national economic construction. It plays an important safeguard role in formulating correct national economic development plans, in economically and effectively carrying out various types of engineering construction, in developing the earth sciences and space technology, and in consolidating and strengthening national defense.

Cartographic work in modern China began at the start of this century. The half century between that time and the founding of New China was a long period of tangled warfare among feudal warlords, frequent civil wars to suppress popular revolution and military and economic encroachment by foreign imperialism. This caused cartographic work during this period to have an obvious semifeudal and semicolonial nature. It mainly served the needs of military and economic exploitation and plunder. Each faction strove to have its own survey organizations and schools and carry out its own cartographic work. They made do for the moment and worked in an one-and-off fashion with no long-range planning or complete programs and without unified technical standards and regulations. Only about one-third of the nation's territory had been surveyed by the eve of national liberation. Moreover, the completed cartographic maps were fragmented, did not fit together, were based on outdated techniques and of very low quality. Very few were of any use. The technical cartography personnel trained throughout this period totalled about 7,000 persons. Most of them changed their profession because they could not find work; only about 1,000 remained on the eve of Liberation. The cartographic foundation passed down from Old China was weak and backward.

The establishment of New China caused cartographic work in our country to enter a new era of flourishing development. The party and government have paid close

attention to the construction and development of cartographic work. In order to safeguard the victorious gains of the people's revolution, a military cartography department and cartography school were established in the PLA system shortly after the founding of the country. They trained cartographic technicians, continually developed basic cartographic work in the eastern regions of China, and laid the foundation for the development of cartography in New China. Along with the development of large-scale economic construction during the First 5-Year Plan, the cartographic ranks in each construction department were expanded many-fold and technical levels were continually raised. This provided cartographic safeguards for control and planning on the Huai He, Huang He, Chang Jiang and other rivers, for key water conservancy and electric power projects and agricultural irrigation projects, for geological surveys and mineral exploration, for prospecting and exploitation of various mineral resources, for factory, mine, and urban construction, for railroad, highway, and shipping construction, and for a large number of other key construction projects.

The establishment of the PLA Cartography College and the Wuhan Cartography College and specialized schools in nearly 20 institutes in various departments has continually provided specialized personnel for the development of cartography through specialized instruction in cartography.

In order to strengthen management of cartographic work throughout the country, unify planning and carry out basic cartography work in an organized manner on a national scale, the State Council established the State Cartography Bureau in 1956 after approval by the 31st Session of the Standing Committee of the National People's Congress. Cartographic work developed and improved rapidly during the 10 years from the time the Bureau was established up to the cultural revolution. On the basis of studying management experiences and advanced technology from foreign cartographic organizations, a fairly complete cartographic systems based on real conditions in China was gradually set up over a decade that included the trilateral forces of state cartography departments, military cartography departments and economic construction departments, as well as cartography production, publishing, scientific research, education, instrument manufacture and repair and other types of units. The number of people working in cartography grew to about 100,000. By 1966, a geodetic survey network using modern cartography techniques had been deployed on a national scale (with the exception of Taiwan Province). Basic national topography maps at a scale of 1:50,000 (1:100,000 in some areas) were plotted for about two-thirds of the nation's total area; 1:10,000 scale basic topographic maps were drawn for about 350,000 square km, as well as a large number of topographic maps at engineering scales. A 1:200,000 scale national topographic map also was compiled, and more than 600 different common reference maps, maps for middle and elementary school teaching, special maps and atlases were published.

In the area of scientific research in cartography, a cartographic sciences research base area was established that included the Survey and Geophysical Research Institute in the Academy of Sciences, the Cartographic Sciences Research Institute in the State Cartography Bureau, the Cartographic Sciences Research Institute in the Headquarters of the General Staff and research organs of the two colleges of cartography. Achievements of practical value have obtained in the application of electronic computer technologies and physical

distance measurement techniques, in the manufacture of conventional cartographic instruments and equipment, and in study and application of analytical photographic triangulation survey techniques, especially in research on mapping techniques in the Qinghai-Xizang Plateau and other areas of special difficulty and in instrument manufacture and testing, and they have played a major role in the development of cartography production. Among these accomplishments, China took the first steps rather early in research and application of many new technologies.

The interference and destruction caused by Lin Biao and the gang of four during the decade of the "Great Cultural Revolution," shut down every cartography department in the country including the units under their administration. A great deal of technical forces were scattered about and much work was stopped. This seriously damaged cartographic work.

Following the re-establishment of the National Cartography Bureau in 1973, survey bureaus were set up in each province and autonomous region and survey offices were established in each municipality according to local systems. Cartography production, publishing, scientific research, education, instrument manufacture and other units were restored or established. Cartography work in all construction departments also developed during the reorganization of the national economy. Cartography work began being restored. During this period, military cartography departments assumed a burden under extremely difficult conditions and finally completed the plotting of 1:100,000 scale topographic maps of the Qinghai-Xizang Plateau and other areas. This was the first time in history that there was a modern topographic map of China on a national scale.

Cartographic work has taken the road toward new development of modernized attacks since the smashing of the gang of four, and especially since the 3rd Plenary Session of the 11th CPC Central Committee. It has closely integrated with the key points of national economic construction and further accelerated the development of topographic maps at a 1:10,000 or even larger scale over a wide area. It began to use contemporary levels to strengthen and reconstruct the various national geodetic survey networks that were deployed during the 1950's and 1960's in order to meet the needs of modernized construction by the state. Moreover, following changes in local conditions, the national basic topographic maps at different scales have been revised, redrawn and updated in order to maintain the currentness of the maps. In another area, space geodetic surveys, compilation of striographs, machine-assisted mapping and drafting, aerial and space remote sensing and other new technologies are now being actively developed, and the sphere of cartographic services is being continually opened up and developed. Moreover, we have begun preparing to construct a basic information system for China's territorial resources that utilizes electronic computer technologies to store and manage the large amounts of basic information collected by cartography departments (the total amount of information of this type now totals more than 10^{13} bits). This will provide rapid and multifunctional services so that a large amount of cartographic information can play a more timely and fuller role in national modernized construction, especially in surveying, studying, developing and managing territorial resources. The cartography management system is also undergoing reform. The decisionmaking rights of basic level units are gradually being expanded and economic methods are being

used to manage cartography production. All cartography units are trying out contractual responsibility for funds, and we are beginning to see results from various forms of contractual economic responsibility systems. The reform of management systems has promoted improvements in production, technology and the level of management. This provides excellent conditions for continually expanding the range of services and enlivening cartography work.

Under the leadership and care of the party and the government, China has established modernized cartography on a substantial scale and level on the weak and backward foundation of Old China in the 35 years since the founding of the nation. The roughly 110,000 cartographic personnel scattered throughout departments across the nation have substantial technical levels and work experience and various types of instruments and equipment, and they are capable of adapting to complex, unusual and difficult tasks and working environments. China has used a fairly short time to complete basic large-scale cartographic work on a national scale and is carrying out a large amount of engineering carrography. This has provided reliable cartographic safeguards for construction and development during various periods in China. Whether in terms of scale, quality or speed, work in these areas has now reached advanced world levels.

II.

Despite the complications and setbacks in the development process and the fact that certain areas still lag behind advanced world levels, cartographic work overall in New China has developed quite rapidly over the past 35 years and the results are very obvious. This clearly shows the superiority of the socialist system in China.

1. Geodetic survey work.

The first era of geodetic survey work in China began shortly after the nation was founded with a primary goal of meeting practical tasks--to provide accurate and reliable plane coordinates and elevation controls for drawing large area topographic maps and various types of engineering surveys.

From 1952 to 1964, we completed the deployment of a national astronomical and geotdetic survey network. The network was evenly distributed, forming 45,000 first and second level triangulation points and traverse points across the country. The points are generally 10 to 20 km apart, and the positions of the points were determined with a real precision of 0.2 meters (surveys before 1958) and 0.1 meters (surveys after 1958). The network was fairly thin in the Qingha-Xizang Plateau, Tarim Desert and the Daxing'anling Forest, but was partially reinforced in the 1970's. Depending on their needs, each survey unit set up theird and fourth level encryption points for this network. This increased tbe total number of points to more than 300,000, forming a dense planar control foundation in all economically developed regions of the country.

The goal of deploying a precise benchmark survey network is to provide precise elevation control. More than 200,000 km of first and second level benchmark line surveys were completed during the 1950's and 1960's, and benchmarks were set up along the lines at distances of 2 to 6 km. The actual error in the first

and second level benchmark surveys is less than 0.5 mm and 1 mm, respectively, multiplied by the square root of the length of the line in kilometers. Because of the high level of precision, the precision benchmark lines were used not only for cartographic controls, but also have been widely used in farmland water conservancy projects and highway engienering construction. The encryption of third and fourth level benchmark survey lines done by each department as needed cover more than 400,000 km.

From 1955 to 1957 we established 24 base points and 88 first-level points to form a national gravitational point network. Different departments have carried out 100,000's of gravitation point encryptions on the basis of this network. Cartography departments used them to organize astronomical and gravitational benchmark lines in order to guarantee precise reduction of the results of surface observations from geodetic surveys. They also were used for determining the partial gravitational field of China in order to guarantee precise launching and tracking of spacecraft. Geology, coal and petroleum departments used it for mineral and energy resources prospecting.

In order to assure that each type of geodetic survey network has a nationally-unified data point system and measurement standards, it was determined during theearly period of network deployment that the 1954 Beijing coordinate system and the 1956 Huang Hai elevation system would serve as unified data points for geographical coordinates and elevations. At the same time, we established a Length Examination and Determination Office and field comparison site to determine lengths, an astronomical longitude main point network to determine human and instrument error in astronomical surveys, and gravity base lines for examination system for various types of survey instruments and tools guaranteed the scientific nature of the survey network.

Geodetic survey work in China entered its second era around 1978. In order to meet the high demands of modernized construction, use the most modern and best technical measures and the highest obtainable precision to strengthen, improve and rebuild the various networks deployed during the first era, resurveys of existing precision benchmark lines were resurveyed and a large number of lines were added beginning in 1976, forming a new national precision benchmark network that was evenly distributed across the country. Field surveys for a new network with a total of 90,000 km of first level lines were completed in 1982 and field surveys for a total of 137,000 km of second level lines is now in progress. There are an additional 100,000-plus km of first and second level benchmark lines in some regions that were measures by seismic, water conservancy and other departments that have not been included in the national network. The national gravity network is now rebuilding the original network with a higher number of levels of precision and is also carrying out a joint international survey.

After about 5 years of data collection and analysis, data preparation, program testing, procedure formulation and other preparatory work, calculations of global adjustments for the national astronomical and geodetic network were interpreted successfully in one try using electronic computers in 1981. During these adjustments, unified processing according to precise mathematical theories was carried out for the more than 1 million pieces of survey data from nearly

50,000 points throughout the network. This permitted derivation of the maximum degree of precision of the network and greatly increased its useful value. This was the first time in the world that global adjustments were successfully carried out for this type of large-scale geodetic network. After the results of these calculations of adjustment are carefully analyzed and studied, measures will be adopted for the needed reinforcement and transformation of the portion of the surveys in the network that were done prior to 1958.

The development of modern science and technology has led to continual expansion in the scope of geodetic surveys. The appearance of satellite geodetic survey techniques in the past 20 years has moved geodetic surveys from the surface into space. In the 1970's, China successfully developed in succession and put into actual use satellite cameras, satellite laser distance measurers and satellite Doppler receivers. Geodetic survey workers in China utilized satellite geodetic survey techniques to complete an integrated survey of the Xisha /Paracel/ Islands and the mainland in 1979. The Chinese Satellite Doppler Geodetic Survey Network made up of 37 survey stations was established in 1981. The various satellite geodetic survey networks have been integrated with the national astronomical geodetic network and can precisely derive earth core coordinates for spacecraft launching sites and tracking stations. Along with the partial gravitational field derived using gravitational survey methods, important cartographic safeguards were provided for launching and correct orbits of China's missiles and satellites, especially this year's experimental communications satellite.

The need for monitoring deformation of the ground surface and engineering structures has caused geodetic surveying to move from static to dynamic surveys. The repeated precision benchmark surveys and precision magnetic wave distance measurement methods were especially effective for monitoring slow and minute deformations. They played a major role in research on seismic mechanisms, successfully predicting the Haicheng and Shongpan earthquakes, monitoring surface subsidence in Shanghai, Beijing and other industrial cities, and monitoring deformation in the large dams at the Xinfeng Jiang and Dan Jiang reservoirs.

2. The drafting of national basic topographic maps.

National basic topographic maps are multipurpose topographic maps covering an entire country drawn according to unified national technical regulations. China's basic topographic maps have a scale system of 1:1 million, 1:500,000, 1:250,000 (changed to 1:200,000 beginning in 1982), 1:100,000, 1:50,000, 1:25,000, 1;10,000 and 1:5,000. Scales larger than 1:100,000 are usually drawn using real surveys. Maps at scales of 1:100,000 to 1:1 million are usually reduced after being drawn at a fairly large scale.

The situation shortly after the founding of the nation was that the country basically had no usable topographic maps. For this reason, it was decided to centralize forces and first develop maps for the entire country at a scale of 1:50,000 (1:100,000 for western regions) in a planned manner in order to deal with the urgent need for national defense and economic construction and planning at that time. This became the first and most important strategic task in cartographic work during that time. Most of the large area 1:50,000 maps were prepared by military cartography departments. Beginning in 1956, rapid progress

was made through a division of labor and cooperation with the primary bodies being the National Cartography Bureau and the Cartography Bureau of the Headquarters of the General Staff. Cartography staffs in geological, water conservancy and other departments also participated. The adoption of aerial photography survey techniques in cartographic work according to unified state technical regulations guaranteed that the completed maps were of fairly high quality. The drafting of topographic maps at scales of 1:50,000 and 1:100,000 for all of the nation's territory with the exception of the Zinghai-Xizang Plateau and Taiwan Province was basically completed during the 17-year period between 1953 and 1969. This greatly strengthened the foundation of topographic maps in China and guaranteed the needs of construction in all areas. Research on cartographic techniques in the Qinghai-Xizang Plateau and other regions of special difficulty also was carried out during this period, and research and testing of radiolocation systems, radio altimeters, infrared photography and other new techniques and methods was also done in a self-reliant manner to prepare a technical foundation for the later development of cartography in the Zinghai-Xizang Plateau. Topographic mapping of this region at a 1:100,000 scale was completed by 1976, wiping out a blank spot in modern China's topographic maps. Completion of all the work involved in drawing the basic 1:50,000 topographic maps for the entire country (1:100,00 in some areas) took only 24 years, and they are first-rate in the world in terms of quality.

In order to provide timely reflections of actual changes in surface features and topography on the basic topographic maps, the first revision and updating of the 1:50,000 maps was carried out from 1960 to 1975, and a second revision has been in progress since 1976. The currentness of the basic topographic maps has been maintained through revision on a fixed schedule.

At the end of the 1950's and the beginning of the 1960's, topographic mapping on a 1:10,000 scale over a large area became the order of the day for water conservancy construction in rural areas of China, in the planting of industrial crops and comprehensive planning of agriculture and industry, and in the large-scale development of surveys of national land use and regional geological sampling work. The old methods of artificial mapping with white paper and of small-scale and scattered mapping could not meet requirements. Based on this situation, state cartography departments began gradually developing the use of aerial photography methods for cartography to draw large area 1:10,000 maps in 1960. By the time the State Cartography Bureau was closed at the end of 1969, a total of 830,000 square km had been surveyed for 1:10,000 maps and 14,000 maps had been completed covering 350,000 square km. After the State Cartography Bureau was re-established, cartography organs in each province, autonomous region and municipality closely integrated with the construction requirements of their locality and continued to carry out the 1:10,000 mapping that had been stopped. Between 1976, when all the cartography workforce was organized and cartography production began in all areas, and 1983, a total of 57,000 maps at the 1:10,000 scale had been completed covering an actual area of 1.42 million square km. An average of almost 8,000 maps covering 200,000 square km were completed each year. The national agricultural natural resources sampling work begun in 1981 required further acceleration of mapping at this scale. For this reason, some cartography units are installing orthographic projection mapping systems and striving to double the number of 1:10,000 maps completed each year over the current levels by 1990.

The drawing of 1:2,000 and 1:1,000 scale topographic maps used in industrial and mining construction, in urban and rural town construction and in other construction projects is now developing continually. Apart from cartography forces in construction departments themselves, state cartography departments also are releasing more and more cartographic forces to carry out mapping at various scales. They are now completing about 26 percent of the total number of maps completed by state cartography departments each year.

Aerial photography survey techniques have developed quite rapidly for more than 30 years in China, and especially in the past decade. Electronic computer technologies and infrated distance measuring technologies have been extended into common use. The image size of aerial photographs has been increased from 18x18 cm to 23x23 cm, which has provided great economic results in cartographic production. The importation and successful domestic manufacture of precision stereoscopic mapping equipment, digitized automatic mapping equipment and orthographic projection mapping equipment is now or soon will be fundamentally transforming cartographic production technologies. Initial results have been obtained in aerial and space remote sensing technologies and their application in cartography, and in study and testing of colored and multispectral photographic materials. These developments in photographic cartography techniques and their application in production have greatly reduced the amount of cartographic field work, reduced the cost of maps, improved the quality of finished maps and work efficiency, and shortened map completion times.

3. Map compilation and publishing work

Map compilation and publishing work has undergone enormous changes in the past 35 years.

Like other cartographic work, map compilation work developed quickly soon after the nation was founded. Compilation of a series of 1:100,000, 1:500,000 and 1:100,000 topographic maps for the entire country was completed during the 1950's and the first part of the 1960's. About 40 percent of the total were compiled using survey information collected after the nation was founded. The reminader, which did not use new survey information, were compiled using old data and informaiton from new cartographic surveys, with fairly good results. Following the continual completion of new 1:50,000 and 1:100,000 maps for the entire country, the previous series of topographic maps also was redrawn, and all of the maps had been updated by 1982. The new 1:1 million topogrpahic map of China published in 1982 contains abundant detail, closely corresponds to actual conditions, uses a fairly scientific means of expression and reflects the topographic characteristics of our country fairly well. Printing techniques also have become more precise. It will become the main foundation for compilation of various small-scale topographic maps in our country.

Various sheet maps of China and the world, as well as atlases of China's provinces and the world were compiled and published during the 1950's and 1960's to meet the needs of production and construction guidance and planning and administrative management at all levels. In 1958, China established the State Geodetic Atlas Compilation Committee and organized specialists in related areas to take up compilation of a large five-volume comprehensive national atlas. A

"Map of Natural Conditions in the People's Republic of China" was published in 1965. An "Atlas of the Provinces of the People's Republic of China" was finalized in 1965 and published in 1969. These maps showed abundant and clear detail and were beautifully printed, but work was stopped because of the cultural revoltuion. This work was resumed in 1981 under the care of the Central Committee and the compilation and publication of five volumes of common, natural, historical, agricultural, and energy resource maps was planned and is now underway.

Since 1975, cartogrpahic organs in most provinces, autonomous regions and municipalities have developed compilation of provincial, prefectural and county maps, published administrative district maps at the provincial, prefectural and county levels, as well as topographic sheet maps, common atlases, economic atlases, agricultural atlases, resource atlases, natural atlases, and so on for each province and autonomous region. All cartographic organs also are organizing and directing a survey of several thousand communes for compilation of maps of current land utilization conditions, farmland and town construction planning maps and so on in each commune. This will play an active role in future socialist construction and development in rural areas.

A unified national Map Press was established in 1954. This strenghened publishing management and improved the content, quality and printing levels of the maps. After the Map Press was established, it began making maps for middle and elementary school education, and continually devloped new nationalities, population, agriculture, geology, climate, historical and other special maps, common reference maps for communications and tourism, and maps and atlases in minority nationality languages, the Chinese pinyin phonetic script and foreign language maps based on needs in culture and education, scientific research, communications and tourism, international exchange and the people's daily lives. More than 1,180 different publications had been published by the end of 1983, with a total run of about 800 million copies. Although the overall level of drafting techniques is rather backward and the types of publications and size of their press runs are far from satisfying the needs of society, causing frequent "map shortages," some of the publications, such as the octavo-size "Atlas of the People's Republic of China," the eight-volume "Atlas of Chinese History," the 16 mo "Atlas of the Provinces of China," and the "World Atlas," the nine-sheet World Mpa," the octavo-sized "Atlas of Malignant Tumors in the People's Republic of China," "Hydrogeological Atlas of the People's Republic of China" and "Climatic Atlas of the People's Republic of China," the 16-mo "Atlas of the Distribution of Droughts in the People's Repbulic of China over the Past 500 Years" and the "Atlas of Asia," and so on contain abundant detail, are based on new design ideas, beautifully printed, and express the fairly high level of map making techniques in our country. They have been given fairly high evaluations by domestic and foreign readers.

The development of cartographic sciences and technology and publishing and printing techniques have played an important role in raising the level of map publishing. Practical results have been obtained in overall theories and research on map projection and design, engraving technolgoies, machine-assisted map-making technologies, typesetting, development and manufacture of transparency records, engraved materials, polyester drawing materials, electrostatic reproduction, and diazo sensitive materials, and development of photographic map reproduction equipment, electronic color scanning equipment, offset printing machinery and other areas.

Cartography in China will continue to play a pathbreaking role in all future economic construction projects and adoption of comprehensive and multilayer development strategies. Apart from continuing to perfect and update existing technologies, we also must continue to import applied technologies suited to our national conditions, meet the crashing waves of the new world technological revolution headon, develop in the direction of multiple spheres, multiple types, high precision, digitization and automation, and make positive contributions to serving the leading edge of economic construction.

12539
CSO: 4008/39

ACCOMPLISHMENTS OF INSTITUTE OF CARTOGRAPHY SUMMARIZED

Beijing CEHUI TONGBAO /GEODESY AND CARTOGRAPHY BULLETIN/ in Chinese No 4, 25 Aug 84 pp 6-10

/Article by Luo Shiming /3157 0013 6900/ of the Cartographic Sciences Research Institute: "A Summary of the Achievements of the Cartographic Sciences Research Institute"/

/Text/ Since the 3d Plenum of the 11th CPC Central Committee, the Cartographic Sciences Research Institute has gradually implemented the principles and policies of the party, especially policies concerning intellectuals. In his speech at the National Science Conference, Comrade Deng Xiaoping treated science and technology as forces of production and placed intellectuals among the working class in China. This has given the utmost encouragement to the broad masses of scientific and technical personnel. Under the leadership of the party, the scientific and technical staffs of our Institute have been gradually expanded over the past several years, and scientific and technical levels have been raised, with obvious economic results. This has made a certain contribution to the development of cartography in our country.

The Institute's specialized organizations include: a Geodetic Survey Research Office; an Aerial Photography Survey Research Office; a Drafting Office; a Place Names Research Office; an Instrument Research Laboratory; an Information Research Office; and a Trial Manufacturing Workshop. Following new developments in the technical sphere, the State Remote Sensing Central Information Department was established in 1981, and the Aerial Photography Survey Research Office was changed to the Aerial Photography Survey and Remote Sensing Research Office. Construction of the Satellite Geodetic Survey Experiment Station may begin before the end of this year.

Under direct leadership by the State Cartography Bureau over the years, our Institute has continuously achieved scientific research results at a certain level though hard work by the broad ranks of scientific and technical personnel and the joint efforts of related units.

1. Geodetic Surveys

We participated in measurement and calculation of the elevation of the world's highest summit, Mount Qomolangma, with the highest precision at the present time

to be 8,848.13 meters and filled in a blank spot on the map of China. Through research on elliptical core positions and regional positions, we calculated geodetic lcoation parameters for China in 1982. In order to permit computer procedures and design, we derived a set of formulas for making adjustments to the national astronomical and geodetic network on the elliptical surface and participated in completion of adjustments in the national astronomical and geodetic network. We explored experimential formulas for the accumulated error of first, second, and third level measurement systems; we gladly cooperated in carrying out surveys of absolute gravity points for the country; we completed a survey for a national satellite Doppler network, and moreover used short-arc adjustment methods for data processing and used conversion parameters to establish an earth core coordinate system for China.

II. Aerial Photographic Surveys

The placement of surface markers according to regional network requirements was done using regional network adjustment encryption planar controls and precise stereoscopic measuring instruments to add topographic benchmarks, and we completed design and testing of new technical programs for 1:10,000 aerial surveys. This has reduced field work and shortened map completion times. Planar lcoations were used as predicted locational values to design multiple forms of elevation adjustment for connecting system error from elevational deformation. We carried out adjustment procedures for iterative computation of planar high points for an independent model regional network, and developed preliminary testing research on the processing of satellite images. Moreover, we also completed measurement of objective lens distortion and research on negative deformation, spectral influences on images and other system errors.

III. Drafting Techniques

We studied reulgations for drafting 1:1 million topographic maps and formulating map types and drafted regulations for drawing 1:1 million topographic maps that have now been published. We proposed map styles and printing techniques for 1:10,000 monochrome photographic maps and provided reference information on making photographic maps for some areas and related departments. Based on the depth of imprints and conversion of drafting laws, key linear elements and other factors for the "Map of the Mawangdui Han Tombs," we participated in joining up and restoring silk maps and studied their content, illustration methods, map completion methods and historical backgrounds. Through research on synthesis of mercaptodiazonium salts and developer formulas and on spreading techniques for black-line diazo printing paper, we applied diazo printing techniques in the reproduction of photographic and line maps and solved the problem of materials consumption in imported equipment. We developed fairly transparent and durable drafting materials with stable dimensions and chemical-coated polyester drafting film.

IV. Instrument Manufacture and Maintenance Work

We completed development of a satellite camera airframe and automatic control and time control systems and carried out static testing. We developed photographic digitizers, digital-controlled drafting machines and orthographic projectors

driven by an industrial controller or microprocessor that can draw topographic contours and a digital-controlled survey instrument for recording them. The orthographic projector has already been put through technical appraisal. We coordianted a stereoscopic coordinate survey instrument, used a microprocessor and developed recording equipment that can automatically print, illustrate and punch out four-way coordinate values. We cooperated with related units to develop the HCT-2 precision stereoscopic survey instrument, and it is being produced in large quantities. We developed the 1818 automatic digital eader and electrostatic map copiers. We developed the IIA photographic digitizer which has now been extended and put into use. We developed a procedural control automatic point spreader and a compiling camera to redraw, combine and project shifts for replication at different scales. We independently installed and debugged the 108-B electronic computer, developed a broad-line printer and added a magnetic-drum and magnetic recorder. We independently debugged the HP electronic computer and solved the conversion of tapes from the MX-1502. We can undertake research on functional analysis of various optical systems and on the design of various optical lenses and automatic balancing procedures for them and other software and techniques, as well as research on mechanical design of precision survey instruments and their special techniques. We can undertake frequency calibration of various electromagnetic wave distance measurement instruments, and with assistance from the State Science Commission New Technologies Bureau and the State Cartographic Bureau, preparations for building the nation's first quality testing center for photoelectric distance measuring instruments are now underway.

V. Remote Sensing Technologies

We cooperated with related departments to design the photographic capabilities of and carry out aerial photography experiments for HCJ-2 color infrared aerial survey photographic film and 6875 black and white panchromatic infrared aerial photography film and used them for aerial and space photography. We cooperated with related departments to combine large image multispectral aerial photography techniques with common aerial photography techniques to derive aerial photography data for both survey and resource uses. We utilized 560 satellite iamges to engrave a 1:2 million satellite photograph map of land use in China. Through connection of the satellite images using identical places on 1:100,000 topographic maps, we compiled 1:500,000 color satellite image and 1:1 milion standard black and white satellite image sheets and combined more than 2,800 1:50,000 topographic maps to complete calculations of the land area of our country. We used sampling methods to complete national and provincial calculations of the area of 10 types of land. We used drafting methods based on 1:250,000 sheet maps to calculate the area of 40 types of land use for the nation and each province. And we developed remote sensing information services for other departments.

VI. Information

A survey of 69 electromagnetic wave distance measurement instruments from more than 200 units was done for preliminary exploration of domestic demand and problems in domestically-produced instruments. We combined scientific research planning, topic selection and importation of new technolgoies to collect information related to cartographic science and technology and even did analytical

research and provided translations. We edited and published "Trends in Cartographic Science and Technology," "Cartographic Science and Technology Bulletin," "List of Foreign Scientific and Technical Information--Cartography," "List of Chinese Language Cartographic Science and Technology Information," as well as the "Network Bulletin." We edited and published "The Current Situation in Marine Cartography Abroad," "Application of Earth Satellite and Remote Sensing Techniques in Cartography," a "Special Edition of Translations on Photographic Maps," "Colelcted Translated Articles on Analysis of Aerial Triangulation Surveys," "Collected Translations on Electromagnetic Wave Distance Measurement," "Special Edition of Translated Articles on High Precision Linear Surveying," "Collected Translations on Automation and Digitization of Photographic Measurements," "Special Edidtion of Translations on Analytical Survey Instruments," "Collected Translations on Automated Map Making," and "Special Edition of Translations on Remote Sensing Trechnolgoies." We also compiled a total of 28 comprhensive analytical information research reports on such topics as "Analysis and Prospects of the Current Situation in Geodesic Surveys,"

VII. Place Names

Based on the spirit of related articles from the Ministry of Foreign Affairs aprpoved by the State Council, we have done a lot of work to achieve international standardization for romanization of Chinese place names. We have cooperated with related units to organize and develop place name censuses of portions of eight provinces and regions including Xizang, Qinghai and Xinjiang, and we edited and published a list of place names for these regions. We published a Chinese langauge pinyin map and pinyin information related to place names. We checked on the remaining place names from foreign sources on the map of China and the State Council has approved their change. We compiled and participated in the compilation of rules related to pinyin, pinyin tables, place name handbooks and othe work. We participated in each UN Place Name Standardization Conference since 1975 and conferences of groups of specialists. We translated articles and reports from related conferences, translated two issues of "Collection of Translations on the Study of Place Names," and edited some chapters of "Lectures on Place Names," We participated in drafting an outline for a national place name census. We participated in part of the work for editing the "Dictionary of Chinese Place Names" and the "Dictionary of Historical Place Names." We did preliminary surveys of the current situation in amateur cartographic place name work and on rare characters used in place names in Guangxi and Guangdong. And we often answered inquiries on the question of writing place names from Xinhua, the Foreign Language Bureau, the Athletic Commission, the Academy of Sciences and other outside units.

Creativity is the soul of scientific research work, and scientific research would be meaningless without creativity. In the area of arranging topics in recent years, our institute has upheld the service of scientific research in cartography to national economic construction and cartographic production, and we also have been concerned with opening up technical spheres and improving basic cartographic theory. The adjustment of the national astronomical and geodesic network was a highly theoretical topic and was closely coordinated with reality in production, and our institute has adhered to research on this topic since the 1950's. In recent years, we have combined the use of electronic

computers for matehmatical modelling of elliptical adjustments and resolved various technical problems that appeared during the readjustment process and smoothly completed total adjustments for 50,000 points across the nation and moved geodesic survey work in China into a new era. Satellite geodesic surveys are an opening realm in China, and the appearance of satellite photographic surveys, satellite Doppler surveys, laser survey satellites and very long baseline interference produced a leap in classical geodesic surveys from theory to practice. Our institute imported satellite Doppler technologies in 1976 and deployed a satellite Doppler network and established an earth core coordinate system. This provided reliable data for China to launch long-range rockets. Moreover, research on satellite photography, laser survey satellites and very long baseline interference technologies is now underway. The development of geodesic surveys will proceed toward examining the integration of space and space physics to accurately survey regional and global changes of the earth. Geodesic surveys have now permeated earth dynamics and other sciences and are even promoting the development in other sciences. In research work on the use of remote sensing technologies to develop surveys and mapping of national land use conditions, practice has proven that developments in this line of research are an excellent example of having new technologies serve national economic construction. China has a vast territory and abundant resources, but the lack of unified data and scientific methods meant that no national land survey was carried out for the past 30 years. As a result, the amount of land resources is unclear, thereby directly influencing agricultural zoning and comprehensive planning for territorial renovation. Although satellite photographs have the shortcomings of low locational accuracy and low resolution, they are multi-spectral and cover multiple periods. They can be analyzed in qualitative, quantitative, locational and temporal terms and combined with 1:50,000 topographic, maps and aerial photograph engraved maps to meet the needs of land utilization surveys. The results of research in this area provided reliable data for effectively controling the occupation of land in rural areas, for strengthening land management and for scientifically carrying out agricultural zoning and territorial renovation. Research on using high resolution remote sensing images in conjunction with computer technologies to carry out land resource surveys and establish a storehouse of basic information on China's land resources is now underway.

Resolutely orienting scientific research in cartography toward national economic construction and concern for economic and social benefits is the principle of scientific research work. Scientific and technical production all fall within the realm of the forces of production. They have a commodity nature and are subject to control by the laws of prices and economics. Scientific research work, especially applied and developmental research, must be concerned with economic and social benefits. Scientific research in cartography is the front line of cartographic production, and earnest adherence to having scientific research in cartography serve cartographic production and national economic construction is the principle of scientific research work in our institute. We have been doing some work that is integrated with national economic construction and national defense construction for years. Examples include adjustment of the national astronomical and geodesic network, establishment of the satellite Doppler network and the earth core coordinate system, satellite geodesic joint

surveys of the Xisha /Paracel/ Islands, China's old secondary triangulation network, research on new technical programs for 1:10,000 aerial surveys, design of adjustment procedures for contour iteration regional networks, debugging and augmentation of the 108-B machine and HP electronic computer installations, research on satellite photographic maps and land resources maps, experimentation on aerial and space photography films, application of diazo printing technologies, production of remote sensing satellite image reproduction materials of different specifications, and other areas and achieved fairly good economic and social benefits.

The development of modern science and technology surpassed the scope of a single nation or single science long ago. Expansion of international contact and striving import and absorb the capabilities of advanced technologies from abroad are important routes for the development of cartography in China. Our institute has been expanding its international contacts for years. Scholars and scholarly groups from 15 nations and regions have come to our institute to discuss scientific topics or install instruments and equipment, and we signed a science and technology cooperation memorandum with Graz University in Austria. A backbone staff for foreign affairs in science and technology has been built through these various forms of international contact, giving us an increased ability to absorb advanced technologies from abroad. Through the common efforts of all comrades in the institute, research is now underway on satellite Doppler surveys, remote sensing cartography, digitization and automation of aerial survey maps, and modern management techniques for cartographic information and results at certain stages have been achieved. This has lessened the disparity between China and the developed countries, but the level of cartographic technology is still low in China compared to the developed nations of the world. Changing this backward situation is an important topic for creating a new situation in scientific research in our institute.

A review of the past primarily serves future developments. According to research work carried out by our institute over the years and integration of existing technical levels and equipment, we will work in the near future to open up new projects within our power and effectively. In the area of geodesic surveys: to analyze data after comprehensive adjustment of the astronomical and geodesic network to provide better technical programs for the astronomical and geodesic network; to further digest satellite Doppler technologies; to study and develop satellite photogrpahy and laser survey satellite work; to establish a satellite geodesic survey experiment station; to refine earth core coordinates and geodesic benchmark areas; and to study and import rapid location technolgoies. In the area of aerial surveys and map-making: to study remote sensing and multispectral photography mapping techniques and update medium and small-scale maps and compile special maps; to study automatic compilation and data storage technologies; to study digitized map-making, specialized map-making and machine-assisted mapping; to carry out compilation and printing of common national atlases; to develop research on standardization of map printing, digitization, new materials and new technologies, and to study historical atlases; to carry out digital ground surface modelling at different scales; to do research on information abstracts search systems and on collection and analysis of intelligence and information. New topics undertaken during 1984 include: integrated adjustment of satellite networks and geodesic networks; substitution of magnetic wave distance measurement

triangulation elevation for third and fourth level benchmark surveys; dioptric corrections of benchmark surveys; digital image processing; on-line aerial triangulation surveys; close photography surveys; standardization of image reproduction projects and quality control system for them; utilization of remote sensing technologies for land resource sampling; integrated surveys and developmental uses of coastal zone and beach resources; microform storage of aerial photographs; development of a 5-km laser distance measurement instrument; establishment of a measurement and testing center for photoelectric distance measuring instruments; development of a stereoscopic coordinate collector, and so on.

China's current economic, science and technology, education and management systems are not suited to development of the forces of production, nor can they keep pace with the new world technical revolution. Reform is essential, because without reform there is no way to proceed. In order to overcome the shortcomings in existing management systems in scientific research units, our institute is now studying and testing the establishment of post responsiblity systems and scientific research responsibility systems.

Over the years, our institute has achieved the preliminary formation of a strong scientific and technical contingent in cartography under the correct leadership of the State Cartography Bureau and the institute Party Committee and through the joint efforts of all comrades in the institute. Looking at our institute's history of scientific research, personnel composition, instruments and equipment and previous results, there is a potential for promoting progress in cartography in China, but there are at the same time many problems. We believe that if we study earnestly, adhere to and uphold the principles and policies of the party, and if we adhere to the ideological ine of seeking truth from facts in our work, reform those systems that restrict the forces of production in scientific research and strive to improve the professional quality of scientific and technical personnel, and solidly and assiduously strive to do good work in all areas, then we certainly will be capable of coming up with scientific research results at a certain level that are simple and unadorned with fairly good economic and social results, of bringing up a farsighted and close working scientific and technical contingent with an upright style of study that is integrated with reality, good at attacking key problems, and has a fairly strong ability to meet emergencies, then the Cartographic Sciences Research Institute will certainly be able to make the needed contributions to invigorating cartography in China.

12539
CSO: 4008/39

PRC OCEANOGRAPHY DIRECTOR ON ANTARCTIC EXPEDITION

OW290321 Beijing XINHUA Domestic Service in Chinese 0822 GMT 26 Dec 84

[Excerpts] Beijing, 26 Dec (XINHUA)--Antarctica is a "sacred land for conducting scientific research" and the "land of treasure." Its unique geographical conditions and natural environment have attracted scientists of many countries to do research work and conduct surveys, while braving hardships and dangers. China has dispatched its first scientific expedition team to the Antarctic to set up an observation station and conduct scientific research there. This is an event of great significance.

This is a remark made by Luo Yuru, director of the Chinese State Oceanography Bureau, at an interview with a XINHUA reporter. While China's "Xiangyanghong 10" scientific research ship and the "No 21" salvage and rescue ship are steaming to their destination, he told the XINHUA reporter the main task and great significance of this expedition.

Luo Yuru said: Antarctica is called the Seventh Continent, with an area of 14 million square kilometers, nearly 1.4 to 1.5 times China's territory. There is little pollution in the Antarctic. There is very little man-made interference in its ecological system and environment. It also has a unique natural environment, providing scientists with a singular place to conduct scientific research. It is of great significance in the study of many branches of science, and the overall environment of the earth. Therefore, people call it the "sacred land for conducting scientific research."

Dwelling on the rich natural resources of Antarctica, Luo Yuru pointed out: Scientific surveys in the past several decades have proven that Antarctica is a "land of treasure." There are more than 220 kinds of minerals in the Antarctic and its continental shelf, with large reserves of petroleum, natural gas, iron ore, and coal.

Luo Yuru said: Right from the beginning, our party and Government have attached great importance to the work of China's expedition to the Antarctic. Comrade Deng Xiaoping had personally written an inscription: "To the peaceful utilization of Antarctica by humanity." The various units concerned throughout the country have given this expedition tremendous support in manpower and material supplies.

Luo Yuru also told the XINHUA reporter of the main task for China's first expedition to the Antarctic. It is to set up an observation station, and survey the Southern Ocean, in order to lay a solid foundation for conducting an overall, and more extensive, survey in the future. However, the voyage will face many difficulties, and there are constant climatic changes in the Antarctic. Therefore, to set up an observation station and conduct a survey in the Antarctic is no easy task. It is necessary to overcome many difficulties. He said: The Chinese expedition team has smoothly passed through two typhoon-generating zones and the Westerlies, and withstood severe tests. From now on, it still needs to overcome many difficulties. However, right now, all the members of the team are in high spirits and full of confidence. They will definitely fulfill their major tasks of setting up the station and conducting the survey, and make contributions to promoting mankind's peaceful use of Antarctica.

CSO: 4008/175

SITE FOR PRC ANTARCTIC OBSERVATION STATION FIXED

OW301532 Beijing XINHUA in English 1433 GMT 30 Dec 84

[Text] King George Island, 29 Dec (XINHUA)--The Chinese Antarctic expedition team decided this evening to set up its "Great Wall" observation station on the fields peninsula, King George Island, 62 degrees, 13 minutes south latitude and 58 degrees, 55 minutes west longitude.

The location was singled out from nine eligible sites after four days of investigations. It was unanimously agreed upon among team members and has been authorized by the Chinese national committee for Antarctic research.

The site was chosen for its favorable position, with an open, 2,000-meter-long coastline not far away and a fresh-water lake nearby which supplies enough water for daily use. The chosen site, surrounded by hills on three sides, is separated from the Penguin Island to the southeast by a small strait which can be used by small investigation boats.

The Chinese expedition team members will hold an oath-taking ceremony tomorrow, followed by the unloading and ferrying of materials for the construction of China's first observation station in the South Pole.

CSO: 4010/53

PHYSICISTS' ROLE IN NEW TECHNOLOGICAL DEVELOPMENT DISCUSSED

Beijing WULI [PHYSICS] in Chinese No 8, 1984 pp 466-468, 462

[Article by Song Feijun [1345 5481 0689] of Beijing Institute of Photographic Mechanics and Technology: "Physicists and New Technological Development"]

[Text] I. Status of Development

Development, or exploration or promotional studies, is the research effort beyond laboratory studies. In the process of converting "knowledge productivity" to "material productivity," development is an important link.

The "materialization" process of a technical accomplishment usually consists of the following steps: basic research → applied research → development → production.

Over the past 30 years, basic and applied research in China has reached a certain level. A large number of scientific and technical accomplishments have emerged every year. Some have reached advanced levels in the world. In the meantime, China also built thousands of large- and medium-sized plants and mines with fairly complete departments and matching capabilities in design and processing. It can be said that things have begun to take shape. However, the economic benefit of the investment is still not apparent. On the one hand, many technical accomplishments are staying in the laboratory stage or even on the scientific article level. Very few of them are actually converted into productivity. On the other hand, the majority of the businesses is still carrying out production with outdated equipment and technologies. For example, only approximately 10 percent of the products in the machine industry can reach the world level in the 1970's or early 1980's. One of the important reasons for this contradiction is our lack of concern about development, resulting in a bottleneck in the materialization of technical accomplishments.

In order to accelerate the four modernizations in China, the Central Government has already adopted a strategic policy that "technological advancement is necessary in economic recovery." Furthermore, technological development is placed at an important spot.

In addition to materials, an extremely important condition to conduct development is the makeup and quality of personnel.

I was a 1966 Physics graduate of Beijing University. Since graduation, I have been involved in the development and fabrication of new products in plants and institutes in the optical instrument industry. My past positions included group leader for new product development, chief designer, leader of the scientific research topic group and director of research laboratory. Presently, I am the associate director of the institute and director of the laser instrument laboratory. Furthermore, I am also the responsible person for two subject areas. I have been working on the front line in development for a long time. The following is some preliminary viewpoints based on my personal experience:

II. The "Talent Spectrum" Requirement in Development research and the Broad Horizon for Physicists

Development research is situated between basic and applied research, and production. This is an area where science and technology begin to mingle. Development research usually has an engineering overtone with many technological problems to solve. It is also frequently a continuation of scientific research. Next, development research often involves many disciplines. Many economically beneficial new accomplishments and products resulted from frontier sciences. Therefore, development research requires a special "talent spectrum." An efficient and productive scientific research team or product development team is frequently composed of technical people from various fields. In this group, a physicist can be very effective.

Physicists have good mathematical background and strong adaptibility. They are familiar with modern experimental techniques as well as research knowhow. In development, they are usually responsible for theoretical verification, experimental simulation, new technology exploration and mastering new devices and new test methods. Drafting product drawings and formulating technical steps are handled by engineering college graduates.

In our research group, there are physicists, engineers, senior engineers with extended experience in instrument design, and young technicians from junior colleges and technical schools. We collaborate closely with well defined duties.

In 1981-1982, we accepted a joint effort with the Institute of Ships of the Ministry of Transportation to develop a "laser diffused spot camera." To use the diffused spot effect in measurement is a new technique developed in recent years. Outside the country, there is only a Swiss company making a similar product. In China, some scientific research work was done in several institutes of higher learning. I was the person responsible for this topic. According to the usual scientific research process, I first conducted a literature review and gave comprehensive reports in the group to allow people to understand this physical phenomenon and its applications. Then, we completed simulation tests with the collaborating institution based on the method described in the literature.

In order to gain a profound understanding of the mechanism of this effect, I carefully studied all the relevant papers and used the most probable geometric distribution method for a quasi-independent subsystem in statistical physics to derive the first order statistical characteristic of the diffused spot effect. Moreover, the second order statistical theory for the size of the diffused spot was also developed. These theories were applied to product design to determine the major parameters of the instrument. Advanced rational plans were drawn up to successfully develop devices such as point by point double screen analyzers with intersecting wide white light beam and narrow laser beam, magnetic directional spatial filters and large aperture Fourier lenses to allow the major indicators of our product to approach those of the Swiss product. Some characteristics are even better.

After the product was successfully developed, we sponsored a seminar on the diffused spot technique in Beijing in 1983 in order to promote this new technology. In the meantime, our own products were used in scientific research and resulted in the publication of five related papers in journals and meetings. My paper entitled "Optical Design of a W2 Laser Diffused Spot Photographic Device" was rated as an outstanding paper in the 1982 Beijing Laser Academic Annual Meeting.

In scientific research work, we are both researchers and designers. In addition, we are the first user of the product. Hence, we are able to improve the technical properties of the product continuously.

The W2 laser diffused spot camera filled a void in China. It received a second class technical accomplishments award from the Ministry of Transportation and the city of Beijing. Furthermore, it was praised by experts throughout the world. This product is currently manufactured by batches with good economic benefits.

Since last year, we began to consider conducting research on the "automatic laser diffused spot information processing system" based on the new technical trend in the world as well as on the request of the users. This project has officially started. The theoretical verification work which I am responsible for has also begun.

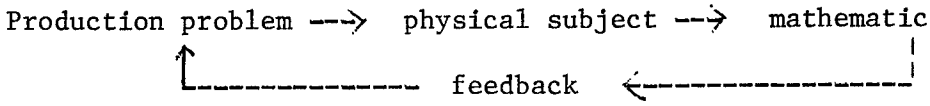
There are seven people in the development group. In the 2 years since 1982, we have developed three products--the laser diffused spot camera, laser scattering optical elastic meter and laser polarized differential flowmeter. Furthermore, we began research work on new products and projects such as the automatic data processing laser elliptical polarizer, two dimensional laser flowmeter and effective bandwidth quality evaluation. One of the important reasons why we made fast progress is we have a complete spectrum of talents. Comrades from various fields and academic backgrounds are contributing their strength to create an ideal project group. In such a group, the advantage of a physicist can be fully appreciated. The weakness of a physicist such as the lack of familiarity with mechanical design and mechanical processing, can also be complemented.

Based on years of experience, I found that development work is an area where a physicist could grow.

III. Mathematical Foundation and Technical Breakthrough

A physicist has relatively better mathematical training, which is related to the depth of understanding of real problems. This point was discussed in the previous section. Another example is given here.

As we mentioned above, in development basic research, applied research, developmental study and production intersect. It involves many disciplines. The technical contents are broad, deep and abundant. In this area, some key technical problems frequently emerge in scientific research and new product design. Solving these problems is usually a prerequisite for success. The entire process of presenting and solving a technical problem may be expressed by the following formula:



The first step is to extract and process a subject matter in production or other applied fields to turn it into a physical problem. The second step is to list the mathematical equations according to the physical problem. The third step is to solve the equations and the fourth step is to provide feedback to production in order to solve the problem. It is apparent that because of good mathematical background, physicists are specialized to work on the first, second and third steps. The fourth step involves feedback and taking technical measures, which may require cooperation from experts in other fields.

It is true that a problem can be solved as it stands. However, it may not work or it may be less effective because of the depth of the problem involved.

I was working on a lens design in a microscope plant in Beijing. The plant manufactured several hundred biological microscopes per month, including thousands of object lenses. Quality evaluation of the object lens of a microscope was an important subject matter not resolved for a long time in China. This plant used to primarily rely on the "point star" method to determine the quality of the image. This method essentially depended on the naked eye to judge the energy concentration and axial synmetry of a point image. Therefore, it is subjective and uncertain. Since I was the chief designer, very frequently I became the "arbitrator" between inspectors and workers. Thus, I was determined to solve the image quality determination problem quantitatively.

From the view point of physics, the conventional point star method detects the degree of energy concentration spatially. Because a microscope is a small aberration system, the measurement error is very large. Furthermore, it is very subjective. The spatial expression of the signal of the system is in the x domain. It can naturally be evaluated in the frequency domain f, i.e., to measure the effective bandwidth of the system. Hence, we began to study the topic "effective bandwidth and evaluation of image quality of a microscope." From information theory, the optical system is the information transmission

channel. Because the capacity of the channel is limited, the signal undergoes smooth filtering. The high frequency component in the signal is lost. Its information content is lower than that of the object. The amount of information transmitted by an optical system can be expressed by the channel capacity.

The imaging relation is a homogeneous Fredholm equation. The channel capacity is the potential of the eigenvalue of this equation. I used the microperturbation method in quantum mechanics to solve this integral equation. Consequently, the quantitative expression for information channel capacity was obtained. Furthermore, other comrades in the laboratory and I designed and developed the specific system to measure the channel capacity. The simulated test was proven to be successful.

Because in depth theoretical work was done, the indicators for evaluating the image quality were well understood. The experimental work was also carried out smoothly. This project is expected to be certified this year. Currently, we are developing the microprocessor software and interface.

In the past it was believed that science major could not work effectively in plants and industrial research institutions. It was also believed that mechanics, electromagnetism, quantum mechanics, fluid dynamics, and mathematical physics are useless in these areas. When I was a student, I also believed in this saying. However, years of experience told me that it was not totally true. The fundamental theories taught in the physics department are the general abstract theories describing the laws of motion in nature. Production activity itself is a complex motion. If one is not satisfied in solving problems superficially (not pertaining to technological or processing problems but more general profound problems), the aforementioned basic theories and advanced mathematical methods must be used to find the patterns and solve the problems in depth. When I have time, I try to study information theory, integral equation and generalized functional analysis, which I did not learn well in college. The current work load is so heavy that I can hardly learn these things as much as I want to.

Since I began to work, I had been responsible for the research and development of over a dozen products. Most products are already in production. Some also received major accomplishment awards in the National Science Conference. These results are jointly created by the comrades in the research and development groups. As for myself, the progress is the result of college training. After reviewing our work, one of the associate bureau chief in the National Instrument Bureau said that "We made a serious mistake in personnel in the past. We did not request for enough physics graduates."

IV. Conclusion

My feelings are mixed after reviewing the experience of my friends and myself.

When I was studying in the physics department of Beijing University, I did not for one moment think about working in a plant or an industrial research institute. All I was thinking was to stay at Beijing University or to work

at the Chinese Academy of Sciences. A historic tide pushed me onto a strange path. In the past, college students, especially physics students, believed that their mission was to understand the world. Very few wanted to change the world. Therefore, work usually stops at publishing papers and presenting accomplishments. Very few accomplishments are "materialized" to produce economic benefits. We don't consider it to be part of the job. In my opinion, this is partly due to the narrow scope of mind of a student. However, it is also caused by the college education back then. The students were biased. I do not understand the present education philosophy in the physics department. However, the viewpoint of those students who are working on their thesis research with me is not too different from 9 years ago.

In addition, physicists rarely work in the area of development and factories. This also has a long social background. Many personnel departments, plant directors and managers know very little about the "value" of physics students. Some people have the misconception that the only profession for physics graduates is teaching. The other important reason is that the small number of graduates is teaching. The other important reason is that the small number of graduates assigned to these units are not capable of demonstrating their effectiveness. Besides restless individuals, the working environment is also less than desirable. Physicists have their own familiar method such as reading the literature, conducting theoretical derivation, and solving problems fundamentally. Some units do not understand and support these procedures. In some units, it is considered to be unorthodox. Moreover, some basic requirements (such as laboratories) cannot be met. In the area of continuing education, the opportunity to work and study abroad is much more limited than working for an institute of higher learning or the Chinese Academy of Sciences. It is hard to blame those physicists who were assigned to those units to request for a transfer back to institutes of higher learning. I knew many such examples, including those who contributed in some areas. It is a great loss in my opinion. The situation is somewhat improved. The "Meeting on the Functions of Physicists" was held last June by the Ministry of Education and the Chinese Physical Society to reassess the effectiveness of physicists in economic growth. It is an encouraging sign.

12553
CSO: 4008/104

RAPID ADVANCES IN GEOLOGICAL WORK

Beijing GUANGMING RIBAO in Chinese 22 Aug 84 p 2

[Article by Sun Daguang [1327 1129 0342], minister of geology and minerals]

[Text] The People's Republic of China has experienced a 35-year history. During these 35 years our nation's geological activities have kept pace with the reconstruction of the state, making glorious advances, making important contributions to our nation's economic construction and military construction.

Over 3,000 years ago our wise and diligent ancestors began to use their mineral resources; later, due to the devastation wrought by the long period of feudal control, the speed of development was very slow. After the Xinhai Revolution, with the importation of modern science, old China began the use of modern geological science, and began geological prospecting. On the eve of liberation, there were only 299 technically trained geological personnel in the country, and no more than 800 persons engaged in full time geological exploration. They were only able to do a small amount of surface exploration and scattered ore prospecting, discovering reserves of only 18 varieties of minerals in 37 years.

As new China was born, a wide new swath was cut for geological activities. At the time of the nation's founding the central government established the Commission for Guiding and Planning Geological Work, bringing together all the scattered geological work efforts. On the eve of the First 5-Year Plan, the state established the Ministry of Geology and Mineral Resources, and every industrial sector established a geological apparatus. Thereafter, in connection with 156 key state construction programs, key prospecting work was carried out in 19 large-scale mine areas: the iron mines of Anshan, Daye, Baiyun'ebo and Xuanhua; the copper mines of Baiyinchang, Tongguanshan, Dongchuan and Zhongtiaoshan; the Gejiu tin mine; and the coal fields of Huaibei and Weibei. In 1956 a nationwide prospecting program was begun. In the 1960's geological data was provided to assist in finding mine areas to aid in the construction of the nation's strategic rear areas. During the 10 years of internal disorder, our great geological workers bore every sort of oppression, but as they continued in their field work, they found many mine areas every year. Several dozen minerals in substantial reserve quantities were found, including iron, coal, copper, aluminum, molybdenum,

tungsten, gold and silver. The oil discoveries in Subei, the East China Sea and South China Sea, the Pearl River Estuary and the Beibu Wan were made during that time.

The 3d Plenary Session of the 11th CPC Central Committee was like a warm ray of sunshine, lighting up the hearts of our 1 billion people, and geological work welcomed an exuberant new springtime. In the 5 years since then a geological work force possessed of more types of production work and utilizing more branches of science has come forward together with the geological rank and file of every branch of industry to fight bravely on the vast reaches of our homeland's land, air and seas. They have provided mineral resource bases one after another for the homeland's four modernizations, one after another they have provided sets of geological data. In the last 5 years the total area covered in regional geological exploration work of every sort adds up to one-half of all the work done in the previous 24 years: 2,670,000 square kilometers of aerial magnetic surveying; 430,000 square kilometers of aerial remote sensing surveying; 1,200,000 square kilometers of 1 to 200,000 regional geochemical sampling. All this has provided results in 820 items of scientific research; 169 of them are of great importance, winning 5 National Invention Awards and 12 Natural Science Awards. Besides this, they have completed block surveys of the future of mineralization for 459 blocks, and produced such important works as "China's Strata" [ZHONGGUO DICENG], "Atlas of China's Geotectonics" [ZHONGGUO DADI GOUZAO TU], "All-China Atlas of Hydrogeology" [QUANGUO SHUIWEN DIZHI TU], "Atlas of the Tibetan Plain" [XIZANG GAOYUAN DIZHI TU], etc. With the expansion of the territory served, geological prospecting has shown manifest results. The number of minerals prospected for has increased from 50 to 90; 629 mineral bearing areas have been discovered, 316 of them large and medium scale areas; progress is being made in 684 mineral bearing areas currently being prospected. Commercial grade oil wells have been drilled in the Pearl River Estuary area of the South China Sea and the Xihu Depression area of the East China Sea. This is of profound significance to the prospects for oil exploration and recovery in all marine areas. Oil and gas exploration in the North Sichuan, Zhongyuan and Subei areas has also made new breakthroughs. Five years of hydrogeological work over 2,340,000 square kilometers has been done and a report on karst water resources in Shanxi and the north flank of the Taihengshan has been produced. In the eastern part of the country the future prospects for nonferrous metals and precious metals have been improved; nonmetallic minerals have been discovered and utilized in all parts of the country. As for the mission concerning the reserves of 19 important minerals stipulated by the Sixth 5-Year Plan, 15 have already been moved up in schedule for completion in 2 years. In 5 years 370 geological reports on availability and design for mines have been produced, the utilization ratio approaching 53 percent.

To sum up, the 5 years since the third plenary session have been years of rapid advances in geological work. China has now discovered 150 minerals, 135 of them in proven reserves. The proven reserves of 20 minerals are in the first rank worldwide: tungsten, tin, molybdenum, antimony, lead, zinc, mercury, iron, vanadium, titanium, sulfur, phosphorus, asbestos, graphite, fluorite, magnesite, etc.

Looking into the future, there are wonderful prospects for China's geological activities. We must continue to reform, keep our feet on the ground, do our work diligently and conscientiously, and then we will make an even greater contribution to the tripling of agricultural and industrial output before the end of this century.

12663
CSO: 4008/386

GEOLOGICAL SURVEY OF XIZANG'S QINGTANG PLATEAU COMPLETED

OW031016 Beijing XINHUA in English 0902 GMT 3 Jan 85

[Text] Lhasa, 3 Jan (XINHUA)--A group of about 100 Chinese geologists has finished a survey of the Qiangtang Plateau, a no-man's land in northern Tibet covering a total area of 490,000 square kilometers some 5,000 meters above sea level.

During their survey, which was conducted from 1979 to 1984, the geologists completed geological charts of the whole area on a scale of 1:1,000,000 and 21,000 km of geological lines, examined 791 km of geological sections and collected 11,000 fossils.

They also discovered 28 types of minerals in more than 200 localities. Reserves of chromium, lithium, borax, sylvite, gypsum and gold are particularly rich there, according to the survey report.

The Qiangtang Plateau covers Ngari and Nagqu prefectures which contain the Karakorum Mountains, the Hoh Xil Range and the Tanggula Range. It is located between 30 and 36 degrees north latitude, 80 and 89 degress east longitude. Summer temperatures rise to 10 degrees centigrade during the day and drop to 30 degrees below zero at night. Owing to the changeable weather and rarified atmosphere, it is virtually uninhabited and wildlife is sparse.

The geologists spent some 500 days on the plateau in the last 6 years.

The survey will be useful for the further study of the formation and evolution of the Qinghai-Tibet Plateau which is the world's highest, largest and youngest one covering an area of 2.2 million sq km. It is considered a particularly important region for geological exploration and has drawn great interest from amny geologists from both China and abroad.

CSO: 4010/55

CHARACTERISTICS OF ALUMYTE DEPOSITS DISCUSSED

Beijing ZHONGGUO DIZHI /CHINA GEOLOGY/ in Chinese No 7, 1984 pp 12-16

/Article by Xiao Zengqi /5135 1073 6386/, Cao Xianming /2580 0341 2494/ and Luo Shengqi /5012 5116 1142/: "Geological Characteristics of Alumyte Deposits In China"/

/Text/ China has good goelogical conditions for alumyte minerlization. It is abundant in alumyte resources and occupies an important place in the world. The following is a preliminary investigation into the geological characteristics of alumyte deposits in China.

I. Metallogenetic Epoch and Ore Formation

The metallogenetic epoch of alumyte deposits extended for a long time. In countries abroad it spanned mainly from the Lower Paleozoic to the Cenozoic, of which Middle Mesozoic and Cenozoic are the most important, while alumyte deposits which have already been discovered in China were formed during the Upper Paleozoic to the Cenozoic and can be divided into seven mineralization periods.

1. Lower Carboniferous mineralization period: one of the principal mineralization periods of alumyte deposits in China. Alumyte deposits were formed in the ore-bearing rock formation of the Lower Carboniferous Datang Formation. Its underlying strata consist of Cambrian-Silurian carbonitite and sand shale and very few are of the Banxi Formation. The principal ore is the high-grade diaspore low-iron and low-sulphur alumyte and deposits are mostly of medium and large scale. The reserves constitute about one-fifth of the national total and are distributed primarily in central Guizhou areas.

2. Middle and Upper Carboniferous mineralization period: the principal mineralization period of alumyte in China. Alumyte was formed in the basal ore rock formation of Middle Carboniferous Benxi Formation or Upper Carboniferous (?). The underlying strata are Upper Carboniferous-Ordovician carbonatite. Currently there are different points of view on the mineralization period of the alumyte strata. Although the overlying strata of the ore-bearing formations belong to a different period, two ore-bearing formations cannot be found in the same section so that they are believed to be products of the same period. The

principal ore is diaspore low-iron and low-sulphur alumyte and deposits are mostly of large and medium scale. The reserves constitute about half of the national total and is distributed primarily in the two provinces of Henan and Shanxi and secondarily in Shandong and Hebei.

3. Lower Permian mineralization period: Alumyte is produced in the basal ore-bearing rock formation of Lower Permian Liangshan Formation (or Tongkuangxi Formation); the underlying strata are Cambrian-Carboniferous carbonitite and sand shale, very few are of the Banxi Formation. The principal ore is diaspore high-iron or high-sulphur alumyte. Depoists range from small to large scale. The reserves are less than one-tenth of the national total and are distributed primarily in Guizhou, Sichuan, Yunnan, Hunan and Hubei.

4. Upper Permian mineralization period: With the Qinling zonal tectonic belt as the boundary, characteristics of the northern and southern regions greatly differ. Alumyte deposits in the northern region were formed in the rock formation composing of arenite, shale, clay rock and coal bed in the lower part of the Upper Permian Nanding Formation (or Shihezi Formation). The principal ore is diaspore high-iron alumyte. Deposits are mostly of small and medium scale and are distributed in a few areas in Shandong, Hebei and Liaoning. Alumyte deposits in the southern region were formed in the basal ore-containing rock formation of Upper Permian Heshan Formation (or Luoping Formation) and covers the erosion surface of Carboniferous-Lower Permian carbonatite and basalt. The principal ore is diaspore high-sulphur alumyte which frequently forms medium-sized and large deposits. They are distributed primarily in western Guangxi and southeastern Yunnan areas and secondarily in southern Shaanxi and central Sichuan areas. Its reserves are less than one-tenth of the national total.

5. Lower and Upper Triassic mineralization period: Alumyte deposits were formed in the basal part of Middle and Upper Triassic as well as the ore-bearing rock formation on the erosion surface of Middle and Lower Triassic carbonatite. Its principal ore is diaspore high-iron alumyte. The deposits are small in scale and the ore is of poor quality. They have limited distribution, few mining areas and little industrial use.

6. Tertiary mineralization period: Basalt weathering crust laterite alumyte deposits. The ore is of gibbsite high-iron alumyte. Deposits are mostly of small and medium scale and the reserves are over one-tenth of the national total. They are distributed in the Hainan Island and southeastern coastal areas.

7. Quaternary mineralization period: Depoists were formed in the quaternary eluvial loess strata and are of the accumulative alumyte deposits. The ore is diaspore high-iron alumyte. Deposits range from small to large in scale. Their reserves are less than one-tenth of the national total and are distributed primarily in western Guangxi and southeastern Yunnan areas.

II. Types of Alumyte Deposits

There are three major types of alumyte deposits in China: sedimentary, accumulative and laterite. Of these, sedimentary alumyte deposits are the most important with demonstrated reserves constituting nine-tenths of the national total.

1. Sedimentary alumyte deposits

Sedimentary alumyte deposits can be divided into two subcategories. (1) Those which were formed on the erosion surface of carbonatite. The ore is primarily diaspore low-iron and low-sulphur alumyte whose reserves constitute almost six-tenths of the national total. Deposits are mostly of medium and large scale with high industrial significance and economic value. They are the main object of exploitation and utilization in China. (2) Alumyte depoists formed in sand shale or on erosion surfaces. The ore is diaspore high-iron and high-sulphur alumyte of which high-iron alumyte is the main deposit and has a definite industrial significance. Their mineralization period is mainly Carboniferous and Permian and to a lesser extent Triassic.

2. Accumulative alumyte deposits

Accumulative alumyte deposits are formed primarily from sedimentary alumyte through weathering and eluviation and transformation by denudation and autochthonous or semiautochthonous accumulation. They are mostly formed in warm and humid areas in low latitutdes. The ore is low in sulphur and has a high alumina-silica ratio. Deposits are shallow and are suitable for exposed mining. In recent years considerable discoveries have been made in western Guangxi areas and prospects are certain. Their mineralization period is Quaternary.

3. Lacterite (or weathering crust or weathering residue) alumyte deposits.

Formed from weathering and eluvation of basalt. This type of deposit abroad is usually large and high-grade and is the main source of alumyte ore. Known deposits of this type in China are all small scale. Their mineralization period is Tertiary.

III. Ore Characteristics

China's alumyte deposits are primarily diaspore ore with reserves constituting above 98 percent of the national total. There are few gibbsite ore.

Monohydro ore is formed primarily from diaspore and kaolinite and secondarily from ferrous and ilmensite minerals. Based on structures they can be divided into earthy, pisolitic-oolitic, clastic and compact ores of which the quality of earthy ore is the best.

Trihydro ore is formed primarily from diaspore, kaolinite and ferrous minerals and secondarily from ilmenite. The ore has sand, amygdaloidal, mottled, honeycomb and compact structures, of which sand ore is of better quality.

Alumyte ore in China can be divided into four industrial types and four grades according to their industrial significance.

1. Diaspore low-iron and low-sulphur alumyte

The ore is primarily high-alumina, high-silica, low-iron, low-sulphur and mediuj-low alumina-silica ratio. This type of ore has a wide distribution,

large reserves and need not be processed before being directly used for production. It is a main industrial type of ore in China.

2. Diaspore high-iron alumyte

The ore is primarily medium-alumina, low-medium alumina, high-iron, low-sulphur and medium-high alumina-silica ratio. Only high-grade ore in this type suits production by the Bayer process and it is an industrial type of ore with secondary importance in China. The alumina-silica ratio of the accumulative ore of this type of ore is more often greater than 10.

3. Diaspore high-sulphur alumyte

The ore is primarily of medium-high alumina, medium-low silica, high sulphur, low to high iron, and medium-high alumina-silica ratio. This type of ore must go through the desulphurizing process before it can be utilized. Because of the high proportion of high-grade ore and because of the large reserves, it has great potentials for industrial use.

4. Gibbsite high-iron alumyte

The ore is primarily medium-low alumina, medium-high silica, high-iron and medium-low alumina-silica ratio. It has little industrial use as its reserves are small, the ore formation is thin and the grade is low.

IV. Ore Morphology and Occurrence

The ore bodies of sedimentary alumyte deposits are mostly strata-like and lenticular while a small number of infundibular and irregular. The ore formations are usually a single stratum and very few are multiple strata. Their top surface is level while the bottom surface is uneven. The thickness varies greatly, being as thin as less than 1 meter or as thick as over 50 meters, but is generally 1 to 4 meters. The area also varies greatly, from as small as less than 0.1 square km to several square kilometers. The interior frequently has karst windows. The occurrence of the ore formation is consistent with the stratum which is generally mild with an inclination less than 30^{o}; some parts hve steep inclination few of which are greater than 70^{o}.

Accumulative and laterate deposits have complex ore bodies and are mostly irregular. The thickness of the ledge of accumulative deposits is generally 0.5 to 10 meters and the ore-bearing rate is generally 0.4 to 1.2 T/M^3. The thickness of the ledge of laterate deposits is generally 0.2 to 1 meter and the ore-bearing rate is generally 0.1 to 0.6 T/M^3. The ore fomration is mild with an inclination generally less than 30^{o}.

V. Mineral Intergrowth and Accompanying Elements

There are numerous types of alumyte mineral intergrowth in China. The overlying strata of alumyte ore-bearing rock formation frequently consist of coal, bauxitic limestone, calcium carbide limestone and oil shale; alumyte ore-bearing rock formation frequently consists of high-alumina clay, semisoft clay, hard

clay, ferrous alumina, iron pyrite, and asbolane. Among the the above-mentioned minerals, coal and various types of clay are of greater industrial use. Mineral intergrowth among different alumyte deposits are different: low-iron and low-sulphur alumyte deposits frequently have intergrowing clay and iron ore. High-iron alumyte deposits frequently have intergrowing ferrous alumina, ferrous and clay minerals. High-sulphur alumyte deposits frequently have intergrowing pyrite. Gibbsite alumyte deposits frequently have intergrowing asbolane and iron ore.

Alumyte ore in China has numerous accompanying element such as gallium, germanium, vanadium, titanium, niobium, tantalum, lithium and potassium. The accompanying elements and their quantities differ in different areas and different types of ore. For instance, alumyte ore in Guizhou has high content of niobium, tantalum and rare-earth elements while that in Henan has high content of potassium; diaspore ahs a high content of gallium while trihydra ore has a low gallium content.

VI. Pattern of Distribution Enrichment of Alumyte Deposits

1. Sedimentary alumyte deposits in China are distributed and enriched primarily in platform regions which have relatively stable earth crust movement and transgression overlapping sedimentary strata succession. They are formed in transgression stages which result from prolonged rise of the earth crust and sinking after weathering and denudation, and the ore bodies are located in the basal part of the transgression overlapping rock formation and above the interface of weathering and erosion. The longer was the period of sedimentary interface, the more favorable it would be to the formation of the alumyte.

Known sedimentary alumyte deposits in China are distributed primarily in the North China platform region, Yangzi platform region and areas in the west section of the South China fold system which had relative stability in Upper Paleozoic. Areas of the continentalization of the Caledonian movement, through weathering and denudation in the long geological periods to the several sedimentary stages of the Hercynian stage, alumyte deposits could be formed within the overlapping sedimentary area where fundamental lithologic, material resource, climatic, paleogeographical environmental conditions were favorable. Caledonian continental movement played an important control role in China's sedimentary alumyte mineralization and the effects were extensive. Control by the Dongwu movement was obvious in the sedimentary alumyte deposits in south China particularly in the initial mineralization in the Upper Permian.

China's geosynclinal regions also have sedimentary alumyte but currently known deposits of this type are small in scale, have complex ore bodies and poor ore quality and are of little industrial use.

2. Sedimentary alumyte deposits in China are mostly distributed in the fringes of old land and old islands. Control of the paleogeographic environment over the mineralization of sedimentary alumyte is obvious. For example, alumyte deposits in central Guizhou were controlled by the bulge in central Guizhou as well as the Guangshun barrier islands; alumyte deposits in western Henan were controlled by the Qinling old land, Zhongtiao old land the Gaoqi old island.

The most favorable paleogeographic location for mineralization was at the border of the old land, in the lakes, marsh lowlands, gulfs and lagoons on the coastal plain as well as in the sea basin surrounded by old islands or confined by barrier islands. A closed or semiclosed sedimentary environment is one of the important conditions for the formation of sedimentary alumyte.

3. Sedimentary alumyte deposits have clear zoning in their surface distribution. Regionally, the zoning from the fringes of old land toward the center of the water basin (that is, from higher to lower grounds) is: high-iron alumyte zone (hematite and chlorite diaspore zone, that is, oxidation-low oxidation zone) toward low-iron and low-sulphur alumyte zone (gaolinite-diaspore or gaolinite-siderite-diaspore zone, that is, low oxidation-low reducing zone) toward high-alumyte zone or pyrite zone (pyrite-diaspore band, that is reducing-strong reducing zone).

4. Although sedimentary alumyte deposits in China formed different positions, areas of distribution and fundamental lithology, vertically the rock-ore formations and the profile sequences of various rock-ore formations of ore-bearing are very similar. From bottom to top they can be concluded as sedimentary iron-alumyte-coal sequence. A relatively complete and typical sequence is:

Overlying rock series: marine or marine-continental interactive facies, limestone or sand shale
Coal-bearing rock series: thin coal layer, carbonaceous shale or heterogeneous clay shale
Alumyte-bearing rock series: alumyte rock or clay ore, alumyte; alumyte rock or clay ore or ferruginous-alumyte rock
Ferruginous rock series: ferruginous clay rock with hematite or pyrite, siderite
--Disconformity--
Underlying rock series: limestone, dolonite, sand shale and basalt

In this sedimentary sequence, the alumyte-bearing rock series always lies between the ferruginous and coal-bearing rock series. This similarity fully shows that sedimentary alumyte deposits of different periods and different positions in China are formed in a similar geological environment.

5. Sedimentary alumyte deposits are mainly distributed on the depositional interface. Laterite or calcareous weathering crusts formed from prolonged, intense weathering are the material basis for of the alumyte produced and the depositional interface is the necessary condition for the formation of alumyte.

Considering the distribution of sedimentary alumyte in China, large and high-quality alumyte deposits with important industrial implications are usually deposited in the foundation on the erosion surface of carbonatite. There are two reasons. First, through weathering and denudation, carbonate provides a rich material source for metallogeny; second, carbonatite easily forms peneplain and rought karst geomorphology which is favorable to mineral enrichment and preservation. The morphology of erosion interface has a certain control over the ore body, scale and ore quality of the attitude of sedimentary alumyte. The ore bed of the central portion of depressed landform is thicker and the ore quality is correspondingly better.

6. Accumulative alumyte series is formed from weathering of connate sedimentary alumyte. It is strictly controlled by the primary deposits and are mostly distributed among nearby ravines, depressions, low and gently sloping fields. The ore quality is also closely linked to the quality of the primary ore. Other controlled conditions for the formation of accumulative alumyte include a damp and hot climate and favorable tectonic karst geomorphology.

Known accumulative alumyte deposits in China are mainly distributed in Guangxi and Yunnan areas; large-scale deposits are mainly located in gentle inclining rock formations or anticlinal tectonic denudation areas of connate sedimentary alumyte, karst depressions and depressions which accumulate weathered alumyte. Weathering resolution causes the formation of sulphuric acid from the sulphur of pyrite contained in the connate sedimentary alumyte. This has a certain infleunce on the deformation and enrichment of accumulative alumyte.

7. Laterite and alumyte and alumyte deposits and sedimentary alumyte deposits have certain similarities in their pattern of mineralization, namely, they go through a laterization stage in the course of mineralization. However, the two are completely different in vertical and horizontal distribution enrichment positions. Vertically the rich alumyte zone of laterite deposits under the rich iron zone and has a relationship of graded transition with the underlying foundation parent rock; while in sedimentary deposits the rich iron zone is located below the rich alumyte zone and has a clear dividing line with the underlying foundation strata, which is a misconformity contact. Horizontally laterite deposits are situated on highland--the tops or ridges of residual hills, while sedimentary deposits are found in lowland--depressed land or basins. The differeences between the two described above clearly indicate that sedimentary alumyte originates from laterite weathering crusts.

Known laterite alumyte in China are mainly distributed in coastal regions or among islands with low latitudes. Favorable conditions for mineralization are: a warm and rainy climate, a terrain with good drainage and parent rock suitable for mineralization. Laterite alumyte in China is mainly distributed in the coastal regions or among islands of Guangdong and Fujian and is deposited in low hill zones and weathering crusts of hill tops and ridge basalt.

VII. Primary Prospects

Based on the positions of the tectonics of alumyte deposits, the geological conditions of mineralization and the geological characteristics of deposits, alumyte in China can be generally divided into four main mineralization regions of the North China platform, Yangzi platform, South China fold system and Southeast Coast fold system.

1. North China platform mineralization region

The North China platform mineralization region is a mineralization region with relatively good conditions for the mineralization of alumyte in China. This region includes extensive areas of Shanxi, Henan, Hebei, Shandong, Liaoning, Beijing, Nei Mongol and Shaanxi. Within the region are the three mineralization epochs of Middle-Upper Carboniferous, Lower Permain and Upper Permian of which

the Middle-Upper Carboniferous is the primary one. From the paleogeographic point of view, this mineralization region is primarily situated south of the Nei Mongol old land, northeast of the Qinling old land and west of the Jiaodong old land and is controlled by these three old land. Based on geological conditions of mineralization and distribution, this region can be further divided into the central Shanxi-northern Shanxi mineralization zone, western Henan-southern Shanxi mineralization zone and central Shandong mineralization zone.

2. Yangzi platform mineralization region

The Yangzi platform mineralization region has relatively good mineralization conditions which are slightly inferior to the North China platform. This mineralization region includes Guizhou, Yunnan, Sichuan, Hunnan, Hubei and southern areas of Shaanxi. Its mineralization period was the Lower Carboniferous Dakuo period, Lower Permian Liangshan period and Upper Permian Longtan period, of which the first two are the main mineralization periods. Deposits are mainly distributed along the fringes of old land and old islands of the Yangzi platform and are sedimentary deposits. The uplifting epeirogenetic movement of the Caledonian period and upper Haixi period (Dongwu movement) and the subsequent weathering, denudation and laterization had definite influence and control on mineralization and the Caledonian movement had a particularly greater influence. This region can be divided into the central Guizhou mineralization zone, northern Guizhou-southern Sichuan zone and the central Yunnan mineralization zone.

3. South China fold system mineralization region

The alumyte mineralization region of the South China fold system spans across the provinces and areas of Yunnan, Guangxi, Guangdong, Hunan, Jiangxi and Fujian. There are two mineralization periods for alumyte deposits in this region: sedimentary deposits resulted in the early Upper Permian; accumulative deposits resulted in the late Pleistocene. Known alumyte deposits are concentrated mainly in the Youjiang geosyncline fold southwest of the mineralization region. Mineralization occurred when the geosyncline consolidated and entered the relatively more stable platform development stage. During the Upper Permian this region was in a stable sedimentary environment which favored the mineralization of alumyte. Ore-bearing rock series are found in the hteropical Longtan, Wujiaping and Heshan of the same period and cover the erosion surface of Lower Permian or Carboniferous limestone. The distribution and enrichment of alumyte are controlled by old land and old islands. Moreover, within the scope of distribution of connate sedimentary alumyte deposits in this mineralization region, there are frequent distribution of superficial accumulative alumyte deposits. This region can be further divided into the western Guizhou mineralization zone and southeastern Yunnan mineralization zone.

4. Southeast Coastal fold system mineralization region

This includes the coastal areas of Guangdong and Fujian. Known alumyte deposits are mainly distributed in the Leizhou Peninsula and Hainan Island of Guangdong and the Zhangpu region of Fujian. The types of deposits in this region were produced in the laterite deposits in the tertiary basalt weathering crusts. The scale of deposits is medium and small. Comparing the mineralization conditions

of the coastal areas and islands in southeastern China with similar types of alumyte deposits abroad, there are definite similarities and we should conduct research on the mineralization of laterite alumyte deposits and the pattern of distribution and enrichment.

Among the above-mentioned alumyte mineralization zones, the three zones of central Shanxi-northern Shanxi, western Henan-southern Shanxi and central Guizhou are important bases of alumyte in China. Western Guangxi, southeastern Yunnan and southern Sichuan-northern Guizhou mineralization zones also have considerable prospects.

9586
CSO: 4008/396

MAJOR STRUCTURAL MATERIALS OF 300 MW PWR NUCLEAR POWER STATION LISTED

Shanghai DONGLI GONGCHENG [POWER ENGINEERING] in Chinese No 4, 15 Aug 84 pp 40-46

[Article by Lu Darong [4151 1129 1369]]

[Text] Among the nuclear power stations in the world, 90 percent of them are water reactors, and most of these are pressurized water reactors (PWR). For this reason, we chose a 300 MW PWR nuclear power station as the first power station to be designed and built by China's own resources. Its flow diagram is shown in Fig 1.

The degree of sophistication, reliability, safety and efficiency of a nuclear power plant depend a large extent on the quality and properties of the construction materials used. During the past 30 years of nuclear power development, there have been examples of premature failure of equipment in nuclear power stations due to improper selection of materials. Therefore, to select the proper construction materials and to increase the research efforts on nuclear materials will be of significant value to the design, operation, and maintenance of nuclear power stations. Nuclear reactors impose the following requirements on construction materials: (1) small neutron absorption cross section; (2) resistance against corrosion by the cooling medium; (3) high strength and plasto-malleability; (4) stability under prolonged use; (5) resistance against radiation damage; and (6) easy to process and manufacture.

This article is primarily concerned with the problem of selecting the major construction materials for nuclear power stations and offers some suggestions for future work. The major construction materials for the 300 MW nuclear power station are presented in Table 1.

I. Selection of Major Construction Materials

1. Main Circuit System

(1) Nuclear fuel

In most cases, uranium dioxide is chosen as the fuel for PWR because it is chemically stable and is compatible with potential enclosure materials

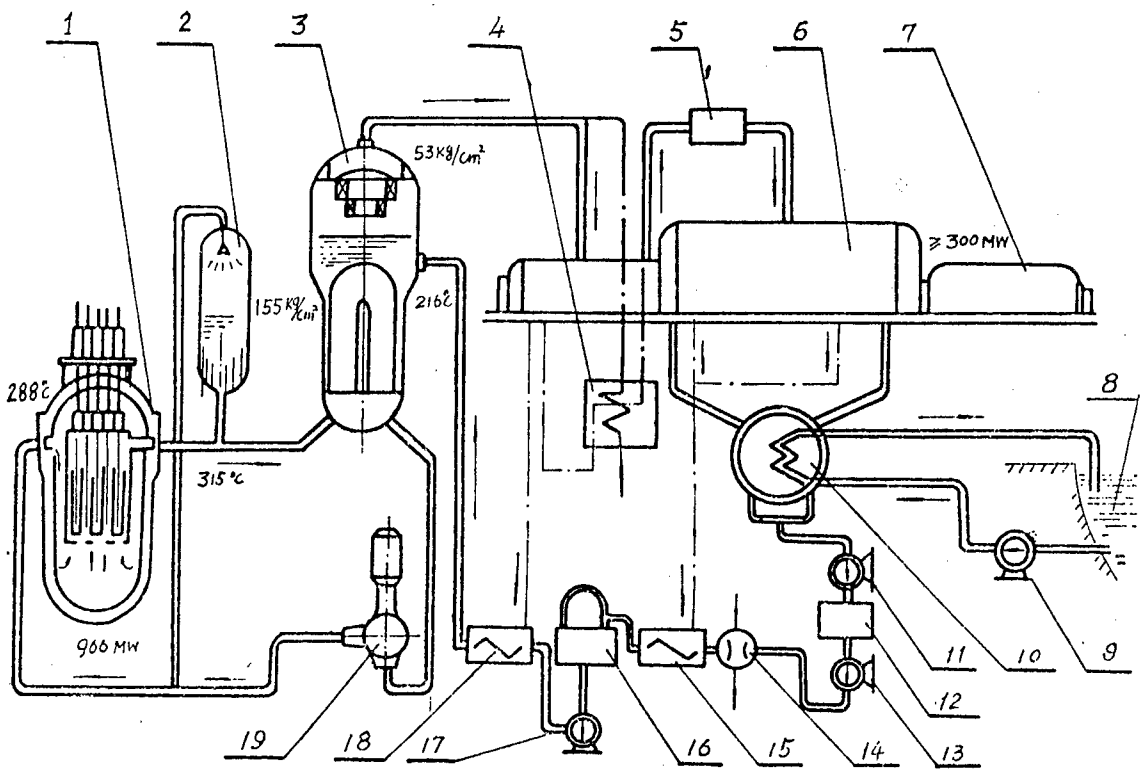


图 1 核电站的工艺流程

1—反应堆；2—稳压器；3—蒸汽发生器；4—疏水箱；5—再热器；6—汽轮机；7—发电机；8—海水；9—循环泵；10—凝汽器；11—凝结水泵；12—除盐装置；13—升压泵；14—抽气器；15—低压加热器；16—除氧器；17—给水泵；18—高压加热器；19—主泵

Fig 1 Flow Diagram of a Nuclear Power Station

Key:
1. reactor
2. pressure stabilizer
3. steam generator
4. hydrophobic tank
5. reheater
6. steam turbine
7. power generator
8. sea water
9. circulating pump
10. condenser
11. pump for condensed water
12. salt removal equipment
13. pressurizing pump
14. bleeder
15. low-pressure heater
16. oxygen removal equipment
17. water-supply pump
18. high-pressure heater
19. main pump

Table 1.

Part	Structural Material
Fuel	UO_2 with disk-shaped end surface
Fuel enclosure	Zr-4 alloy annealed tubing
Pressurized reactor container	Forged and welded S-271 (18MnNiMoNb) low-alloy steel (corresponding to U.S. A508III)
Inner lining and sealing surface	Pad welding of 00 Cr26Ni2Nb stainless steel, 00 Cr19Ni70Mn3Ni3 nickel base alloy and 00 CR17Ni70Mo5Fe4Mn3(M-10) nickel base alloy
Main bolt	18 CrNiWa forging
Reactor internal components	321 stainless steel (hanging basket, etc) Inconel 718 (support keys), 1Cr13 (pressing rings)
Welding wire, core and flux for welding pressurized container	H06Mn2NiMoA welding wire, H05MnNiMoA welding core and HJ153 (SiO_2-Al_2O_3-CaF_2-MgO residue series) flux
Positioning frame & braze	0.3mm GH-169 (Inconel-718) alloy plate and Cr12Si10Ge2P15Pd5FeNi brazing material
Control rod & enclosure	Ag-In15-Cd5 alloy, 0Cr18Ni10Ti
Combustible toxin & enclosure	Boron stainless steel (0Cr18Ni15B), 0Cr18Ni10Ti
Control rode drive mechanism	SG-6 drill base alloy (pin claws), 17-7PH (annular rod), GH-132 (sleeve axle), 316 stainless steel (sealed enclosure), Cr25Ni20 (damping axle), GH-145 (Inconel-740) (spring material)
Drive tube seat and upper & lower steam generator brackets	Inconel-600 alloy
O-ring seal	Silver coating on GH-169 tubing
Main tubes and valves	321, 31b stainless steel
Steam generators heat transfer pipes	Cold-drawn and cloudburst-heated Incoloy-800 alloy pipes (Ø22x1.2)
Main pump & insulating layer	304 stainless steel (pump housing 2,277 mm high x 318 mm thick) (foil thickness of ins. layer < 0.05 mm)
Main condenser & sea water heat exchanger	TA_2 industrial pure titanium pipe and plate; water chamber made of neoprene-covered carbon steel
Main pump axle and valve seal	Tungsten carbide rings, soft graphite
Non-metallic protective coating	Organic silicon heat-resistant self-drying paint; 73-epoxy paint with no solvent; G64-1 ethylene perchlorate strippable paint; neoprene, fiberglass (used on carbon steel), cashew paint (for furniture), plastics, asphalt resin, ceramics, stainless steel (for composite surfaces)

(e.g., zirconium alloy and stainless steel); it also remains dimensionally stable under radiation and has a high melting point; furthermore, it can be produced simply and economically by using condensed uranium hexaflouride obtained from diffusion plants. The main disadvantage of uranium dioxide is that its heat conductivity is very low, and it may be further reduced by radiation; but this effect becomes less significant when fuel consumption exceeds 2,000 MW-day/ton. The advantage of high fuel consumption due to its outstanding chemical stability and dimensional stability under radiation more than compensates for uranium dioxide's other disadvantages, and therefore justifies its use as fuel for nuclear power stations.

(2) Enclosure materials for fuel elements

Fuel elements are the key component for achieving nuclear fission and for converting nuclear energy into heat; the enclosure is used to contain and to support the fuel elements to form fuel rods. The main enclosure materials used in PWR include zirconium alloy and stainless steel.

Zirconium alloy has very small absorption cross section (0.24 barn) and good anti-corrosion properties in water below 360°C; its annual corrosion rate is less than 0.01 mm. Its high-termperature mechanical properties are satisfactory, with $\sigma_{0.2}$ equal to 13 kgf/mm^2 at 375°C; it also has good resistance against high-temperature radiation, its total elongation coefficient and average elongation corefficient under high-temperature radiation of 1.53×10^{21}n/cm^2 (> 1 MEV) are respectively 8 percent and 0.7 percent. Its main disadvantage is its tendency to absorb hydrogen to form zirconium hydride, which makes the material brittle. In order to reduce hydrogen absorption to an acceptable level of 250 ppm, most countries use zirconium-4 allow as enclosure material.

(3) Control rod absorber materials

The most widely used materials include silver-indium-cadmium allow and boron stainless steel. Ag-In-Cd alloy has good nuclear property, high conductivity, and is highly stable under radiation; it is also easy to process and relatively inexpensive.

(4) Combustible toxin materials

Solid combustible toxin materials must satisfy not only the requirements of neutron absorption but also the requirement of combustibility. Thus, at the end of reactor life, the neutron absorbing material will be essentially exhausted, and the excess reactants will be completely released. In terms of nuclear properties, the best combustible toxins are boron and certain rare-earth elements.

Boron silicate glass is a good combustible toxin material. It is easy to process, inexpensive, and uniformly distributed; it suffers relatively little swelling under radiation, and its tendency of iodine stress corrosion (PCI) is quite low. But during its use helium will be 100 percent released, creating the possibility of creep collapse; also, it is not compatible with high-temperature water.

We are now planning to use boron stainless steel initially, but we shall continue to study boron silicate glass by conducting corrosion tests in high-temperature, high-ressure water and radiation tests.

(5) Neutron source materials

In order to ensure safe starting of the reactor, two primary neutron sources and two secondary neutron sources are provided.

Based on China's current production capability, we plan to use ^{210}Po-Be as the primary neutron source and ^{124}Sb-Be as the secondary source.

(6) Enclosure tubing materials of control elements

Control elements include control rods, combustible toxin rods, and primary and secondary neutron source rods. All these elements are contained in enclosure tubings which maintain their shapes and their dimensional stability, and prevent the control materials and neutron source materials from being corroded by the high-termperature, high-pressure water; they also serve as containers for the helium gas released by the control elements during operation.

The 18-8 stainless steel not only has high strength but is also resistant against corrosion and radiation; therefore, 304 steel is widely used abroad as enclosure material for control elements. However, another consideration is the fact that two ends of the enclosure must be welded to the end plugs. The bi-phase austenite stainless steel welded junction is superior to the pure austenite junction in terms of inter-crystal corrosion resistance and resistance against thermal cracks. For this reason, we chose OCr18Ni9Ti as the control rod materia。

(7) Positioning frame material and its grazing material

The positioning frame is intended to maintain accurate lateral separation between the element rods during the design life of the reactor. It is welded to the control rod guide tube and the upper and lower tube seats to form a fuel element frame structure which ensures the correct shape and provides rigidity and strength for the fuel elements.

With the exception of zirconium alloy frame used by the U。S。 Combustion Co, most of today's PWR nuclear power stations use Inconel-718 allow frames or bi-metallic frames, which are made of zirconium allow strips and Inconel-718 alloy springs. It is widely used as frame material because of its extremely high elastic limit and yield strength under high temperatures, its creep strength, and its good forming and welding properties.

Based on the requirements of positioning frame materials, we have imposed limits on the trace elements of this allow; i.e. Co, Cu, Ta are limited to less than 0.1 percent, and B content is limisted to less than 0。002 percent.

In other countries, BNi-7 (Ni-13Cr-10P) is often used as the brazing material for Inconel-78 alloy frames. It has the desirable properties of low melting point, ease of processing, and resistance against corrosion and radiation; but it has low strength and is quite brittle, hence the Inconel-718 alloy strips must be first nickel-plated before brazing. For this reason, we have developed the Ni-Cr-Fe-Ge-P-Pd series brazing material.

The mechanical property of the weld junction is: $\sigma_b \geqslant 35$ kgf/mm at room temperature; its strength increases slightly after being exposed to radiation.

(8) Steel used for the pressurized container

The pressurized container of the reactor is one of the major component of the primary circuit. Its main function is to contain the radioactive core of nuclear fuel elements where fission takes place; it also provides a sealed container for the high-temperature and high-pressure coolants. Over a period of 30 years, the accumulated neutron flux can reach 5×10^{19}n/cm^2. Therefore, the container material must satisfy the following requirements: resistance against embrittlement by neutron radiation, high fracture malleability, sufficient strength, good weldability and hardenability, which is a required property for bulky components.

China began to develop a steel product for pressurized container in 1973 by adding 0.6-0.9 percent of Ni to its steel product 18MnMoNb. This product, which was given the name S271 steel, corresponds to the U.S. products A535B and A-508-II steel. Its key technical requirements as specified by the design department are as follows:

Chemical composition: C:0.17/0.23, Si:1.15/0.30, Mn:1.2/1.5, P $\leqslant$ 0.015, S $\leqslant$ 0.015, Ni:0.6/0.9, Cr $\leqslant$ 0.25, Mo: 0.45/0.65, Cu $\leqslant$ 0.05, Nb:0.02/0.06, Co $\leqslant$ 0.02, B $\leqslant$ 5 ppm; also, low-melting-point trace impurities such as Sn, Sb, As, etc, must be strictly controlled.

Mechanical properties: $\sigma_b^{350°C} \geqslant 56$ kgf/mm^2, $\sigma_{0.2}^{350°C} \geqslant 35$ kgf/mm^2, $\sigma_5 \geqslant 18\%$, $\varphi > 50\%$.

Drop test: $T_{NDT} \leqslant -10°C$.

Shock test: $C_V^{-10°C} \geqslant 5.2$ kgf·m/cm^2, $C_V^{NDT+33°C} \geqslant 8.7$ kgf·m/cm^2, lateral expansion $\geqslant 0.9$ mm, upper platform energy $C_V^{EUS} \geqslant 13$ kgf·m/cm^2.

Radiation performance: when it is subject to radiation of 270°C, 3.59×10^{19}n/cm^2 neutron flux, and if an equivalent value of 5.2 kgf·m/cm^2 is assumed for C_V, then the corresponding change in converted temperature $\Delta T \leqslant 30°C$.

(9) Welding materials for the main seam

The main welding seam of the pressurized container is the annular seam which connects all the annular forged parts. It is welded using union-melt technique with a hand-welded base.

The welding wire is developed from the H08Mn2MoA (used to weld 18MnMoNb) wire by adding Ni and maintaining strict control of the harmful gas elements. The resulting H)6Mn2NiMoA wire, or simply called the 548 wire, has higher resistance against fracture, higher shock malleability at low temperatures, and higher resistance against embrittlement by radiation.

The union weld flux is produced from the 250 flux by modifying the mix ratio and the PH level to improve its welding performance. The resulting product is the HJ153 flux of the SiO_2-Al_2O_3-MgO residue series.

The hand-weld welding rod has a core of H05MnNiMoA welding wire coated with low-hydrogen residue series consisting of mainly marble and fluorite; a small amount of pure iron powder is added to improve the welding and mechanical properties of the rod. It is called the HT271 rod.

(10) Stainless steel pad welding materials for pressurized container

In order to prevent the low-alloy steel from being corroded by water under pressure, a layer of stainless stell thicker than 6 mm must be pad-welded to the inner surface of the container. In general, large-area pad-welding is accomplished using union-melt strip electrodes. In order to avoid embrittlement due to the release of carbides at the junction of the transition layer and the base material, ultra-low carbon steel is used.

In addition, the sealed surface of the pressurized enclosure must also be pad-welded to achieve extra hardness because it not only must be resistant against corrosion but also provide a good seal. Most countries use Inconel-606 for this purpose, but we decided to use the Chinese-developed M-10 alloy whose chemical composition is as follows: $C \leqslant 0.03$, Fe: 3.5/5.5, Mn:3.2/3.8, Cr: 15/17, $Si \leqslant 0.025$, $Al \leqslant 0.5$, Mo:4.5/5.0, $S \leqslant 0.015$, $P \leqslant 0.015$, with the remainder consisting of Ni.

(11) Materials for members inside the reactor and for the main pipes

The most widely used material for members inside the reactor is AISI304 steel, followed by 316 steel; West Germany uses 347 steel, and the Soviet Union uses 321 steel. We plan to use 321 (Ocr18Ni9Ti) stainless steel as the main material for reactor members for the following reason: due to equipment limitations, the bulky hanging basket cannot be processed as a unit after welding, hence it is more prudent to use carbide-stable stainless steel.

Most countries use 316 stainless steel as the material for the main pipes. We are currently conducting a comparison test of the 316 and 321 steel pipes to arrive at a final decision.

(12) Materials for the control rod drive mechanism

Project 728 uses a magnetic hoist type control rod drive mechanism whose main components consist of the magnetic poles, the armature, the annular rods, the pin claws, the damping axle, the sleeve axle, the magnetic inductive section, and the sealed enclosure and springs.

Because the annular rods and the pin claws undergo repeated engaging and releasing actions, they must be made of wear-resistant materials. We use 17-7PH stainless steel for the annular rods and SG-6 cobalt-base alloy for the unit-construction pin claws. They proved to be quite satisfactory in war tests.

The sealed enclosure is a component that must endure high temperature and high pressure conditions; we plan to use 316 stainless steel as the material for the cylinder. The cylinder is thermally covered with a layer of non-magnetically conducting 316 steel and a layer of magnetically conducting No 10 steel.

The damping axle must have sufficient strength because it is subject to loads and shocks; we plan to use Cr25Ni20 stainless steel and GH-132 nickel base alloy.

We plan to use GH145 (equivalent to Inconel-750) nickel base alloy for the springs, OCr13 for the magnetic poles and armatures, and No 10 steel for the magnetic inductive sectionand the magnetic yoke.

2. Secondary Circuit and Auxiliary Systems

(1) Materials for the heat-transfer pipes of the steam generator

During the past 20 years, a significant number of PWR nuclear stations suffered cracks in heat-transfer pipes due to stress corrosion and other corrosion damages; it is one of today's major causes of frequent accidents at nuclear power plants. In selecting materials for heat-transfer pipes, we have used over the years the 18-8 Ti austenite stainless steel, the new No 13 alloy (00Cr25Ni35AlTi), and the Incoloy 800 (improved). The main reasons for selecting the cold-drawn and cloudburst-treated I-800 pipe material are as follows:

i) Based on the operating experience of the 8 nuclear power plants built by KWU of West Germany (7 were built by the river, 1 by the seashore), the use of I-800 was quite successful; there has not been any major accidents since 1972.

ii) I-800 has very low nickel content (compared to I-600), which reduces the radioactive dosage and the rate of release of corrosive products in the water of the primary circuit.

iii) In the high-temperature pure water adjacent to the primary circuit, particularly when the pH level is greater than 6.3, I-800 has higher resistance against inter-crystal corrosion than I-600.

iv) I-800 is very similar in composition to the new No 13 alloy developed in this country.

(2) Tubing and plate materials for sea water main steam condenser and heat-transfer pipes of heat exchangers

The materials for heat-transfer pipes used in nuclear power plants can be divided into three categories: copper alloy (Cu-Zn, Cu-Ni), stainless steel, and industrial pure titanium. Most nuclear power plants along the seashore use copper alloy pipes, which often develop leaks due to corrosion when the sea water has high sand content, and lead to power outages. Since the sand content of sea water used by our nuclear power plant usually exceeds 1,000 ppm, it is unsafe to use coppy alloy. For this reason, project 728 will select industrial pure titanium as the material for heat-transfer pipes and plates. Although the initial cost is rather high, it is economically justified in the long run because the expensive maintenance and repair costs can be avoided.

However, there are also problems associated with using titanium; the main problem is its tendency to absorb hydrogen and become brittle. For example, when titanium is in contact with certain other metal, its surface will produce H_2 and lead to hydrogen absorption; when temperature exceeds 80-120°C, the titanium is sea water steam condenser is likely to be damaged by hydrogenation. In addition, hydrogen embrittlement can also be caused by corrosion of the seams and by high stress conditions.

(3) Materials for auxiliary systems

In most nuclear power stations, 0Cr18Ni9Ti or 1Cr18Ni9Ti stainless steel is used as structural material for the chemical volume control system, the boron retrieval system, the purified water systems, the water and waste drainage system, the safety injection and spraying system, the 3-wastes treatment system, and the waste fuel storage pool. Since they are in contact with strong alkalines and acids, chlorides, boric acids, water that contains organic substances, condensed radioactive waste liquid (e.g., fission products, tritium water, activated corrosive products, etc), waste gas (e.g., iodine, xenon, krypton), etc, the containers, evaporators, heat exchangers, pumps, valves, pipes and sealing materials used in these systems must be made of corrosive-resistant and radiation-resistant stainless steel.

In addition, carbon steel is commonly used as structural material for the cooling system of the primary circuit and the seawater cooling system (except for special material) of the tertiary circuit of the reactor. These equipment and structural materials are often used under adverse conditions such as high temperature and high pressure, washout by flowing water, high-moisture atmosphere, and medium containing large amounts of Cl^- and other impurities. Therefore, effective anti-corrosion measures must be taken when using the low-cost carbon steel. For example, the large diameter carbon steel pipes used in the seawater cooling system must be equipped with rubber linings and electro-chemical cathode protection devices; the exterior must be coated with approximately 200 μm of asphalt.

(4) Non-metallic protective coating materials

The most common method of protecting the carbon steel equipment of nuclear power plants is to apply coatings of paint. The selection of paint is

determined by the conditions under which the equipment is used; e.g., the amount of corrosion of the medium, the temperature level, and the dosage of radiation.

The corrosion-resistant and heat-resistant paint which has been used in industry with great success can be used to protect those reactor structures not subject to radiation such as the compartment located near the water drain pipes, the exterior shell and wall structures, the water supply chamber, the water purification equipment and pumps.

When subject to radiation, many paints and coating materials will undergo irreversible chemical transformation and lose their protective properties. Therefore, in a radioactive environment, the selection of paints and coatings must be based on a study of their radiation stability properties.

II. Future Work

While a large amount of tests, research and trial production work have been carried out in this country, there still exists large gaps in many areas when compared to the standards of other countries. In order to further develop China's nuclear industry, we must concentrate our efforts in the following areas:

1. The nuclear fuel UO_2 core produced in this country is basically comparable in quality to foreign products, but currently we do not have a complete set of data of its properties (.e.g, mechanical, physical, and radiation properties). Furthermore, we must develop a UO_2 dore with smaller density and less radiation swelling, as well as good dimensional stability.

2. Extensive tests and research should be carried out to determine the properties, particularly the mechanical properties of Zr-4 alloy enclosure material so they can be used in future designs. Also, we should strive to improve the structural quality of enclosure pipes by studying the effects of manufacturing techniques on material properties in order to reduce hydrogen absorption, and to increase material strength and ductility. Methods of testing the orientation of hydrides and technical indices of the orientation factor F_n should be established; and studies of iodine vapor stress corrosion cracks caused by the interaction between UO_2 core and Zr-4 pipes should be carried out.

3. In order to improve the effectiveness of fuel elements and to conserve neutrons, we must develop all-zirconium or bi-metallic positioning frames and guide tube materials for the fuel components.

4. Significant efforts have been devoted to the development of materials for the pressurized containers, the main pipes and the main pump; however, due to project schedule limitations or poor product quality control, the research work should be intensified and production conditions should be improved.

For steel material used in pressurized containers, we should continue our research efforts on such topics as the effects of trace elements, embrittlement caused by radiation, and fracture malleability, as well as fracture resistance and low-temperature shock malleability of the main weld seam region. In the case of the main pipelines, we should conduct studies of tubings with qualified manufacturing properties (including bent rubings and three-way pipes), field welding techniques, and non-destructive inspection techniques.

5. Although we have decided to import tubing materials for the steam generator, we must still perform the inspection of material properties and the welding operation (including pad welding of tubes and plates); in addition we must decide on a course of investigation of our own tubing material (I-800 or I-600), and conduct extensive tests and research in the hope of producing our own U-shaped heat transfer pipes at the earliest possible date.

6. China has very little experience in the production and operation of all-titanium steam condensers and heat exchangers, hence, it is necessary to being research and development work in this area.

7. Significant efforts must be devoted to the research and development of non-metallic coating materials and composite surface materials such as epoxy fiberglass for nuclear application so they can be standardized and serialized.

8. Efforts must also be devoted to the exploration of new alloys and new manufacturing techniques in order to continue design improvement and to ensure the safe operation of nuclear power plants over extended periods of time.

3012
CSO: 4008/11

RESEARCH, DEVELOPMENT OF LASER GLASSES IN CHINA

Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 11 No 8, 20 Aug 84 pp 449-459

[Article by Gan Fuxi [1626 4395 3588] of the Shanghai Institute of Optics and Fine Mechanics, Academy of Sciences]

[Text] After the appearance of the first ruby laser in the early 1960's, China's glass workers began to analyze and investigate the possibility of fabricating lasers from materials in the glass state.[1] A year after Snitzer first reported lasing in neodymium-doped silicate glass,[2] China also succeeded in achieving lasing from neodymium-doped silicates (in 1963).[3] The following year, an output energy of 100 J and a 1 percent total efficiency were achieved in experiments using glass rods measuring 16 x 500 mm, and second-harmonic lasing and spectral measurements were also reported for neodymium-doped glasses.[5] By 1966, neodymium-glass lasers in China had reached output energies of several thousand joules and output powers of several hundred megawatts, which approached the best values reported abroad.[6] China was also among the first nations to report lasing from borate and phosphate glasses (in 1965).[4]

Neodymium-glass made in China is used in all of China's high-energy, high-power solid-state laser devices now under development. Some of these glass products have been perfected and put into production; they are used in low- and medium-power solid-state lasers employed by hundreds of manufacturing plants and technical personnel, and their economic benefits have been considerable.[7]

In the following sections, we will summarize various aspects of the work which has been done.

1. Development of Neodymium-doped Laser Glasses

The earliest neodymium-glass lasers were all based on barium crown optical glass, as reported by Snitzer. Since this glass has poor chemical stability and tends to lose its transparency, we changed the components of the glass in order to improve its physicochemical properties. This work resulted in the trial manufacture of N_{01} type-I glass, in which neodymium doping was employed for the first time in China; this glass met all of China's pre-1966 requirements for the development of Nd-glass lasers. However, this type-I glass has several disadvantages, which include a high smelting temperature and a large

coefficient of thermal expansion (CTE). We therefore also selected a series of crown and boron crown glasses (optical glasses whose technology was fairly well advanced) and doped them with neodymium. The doped glasses were then tested for luminescence and lasing; the type-III (N_{03}) Nd-glass, a hard crown glass with an Na_2O-CaO-SiO_2 matrix, was selected on the basis of these experiments. These results showed that N_{03} glass has technological properties which are superior to those of N_{01} glass and has greater chemical stability; moreover, it has greater mechanical strength and a higher laser output efficiency. As a result, N_{03} glass has become China's best-developed neodymium-silicate glass product, and high-quality specimens of large size can be grown in both platinum and ceramic crucibles.

A series of experiments were carried out in order to make Nd-glasses more resistant to damage by high-energy laser pulses, increase the fluorescence lifetime, raise the amount of energy that can be stored in multistage traveling-wave amplifiers (xenon optical pumping lamps with long pulse lengths), and regulate the glass composition and improve its quality (e.g., decrease the CTE, increase the elastic modulus, mechanical strength, and thermal stability). For example, experiments were carried out on the properties of silicate glasses containing large amounts of SiO_2, such as the type-IV (N_{04}) Nd-glass (SiO_2 > 80 percent) and Nd-doped glass with SiO_2 > 90 percent; Nd doping levels were also selected for the type-VI (N_{06}) borate silicate glass (R_2O-B_2O_3-SiO_2). These glasses have good resistance to thermal vibration and are more resistant to laser-induced thermal damage. However, they have not found wide application because of technical difficulties which make it difficult to obtain specimens of good optical quality (these glasses require high-temperature smelting equipment and refractory crucible materials). The type-VII (N_{07}) Nd-glass has a K_2O-SiO_2 glass matrix containing up to 80 percent SiO_2; N_{07} has a fluorescence lifetime of up to 800 μsec, produces little superradiance (fluorescence) in laser devices, and yields output beams with good directivity. However, its efficiency is low when used in pulsed oscillators because of its low stimulated emission cross section. The technological properties of N_{07} glass are favorable for smelting using ceramic crucibles, and large glass rods with good optical properties have been fabricated.

Because the field produced by the optical pumping is nonuniform, thermal distortions are generated in the Nd-glass, which in turn distort the optical pathlengths in the glass and degrade the directivity properties of the output laser beam. Experiments demonstrate that these distortions can be decreased by lowering the temperature coefficient β of the refractive index of the glass and decreasing the thermo-optical parameters P, Q and W. By investigating the relationship between the glass composition and the thermo-optical parameters we were able to improve the composition of the type-I and type-III Nd-glasses and develop the N_{08} and N_{09} Nd-glasses, for which the thermo-optical parameters are considerably lower. Neodymium-glasses are susceptible to thermal splitting and explosion when used in equipment operating at high repetition rates, which is a serious problem. We therefore developed N_{10} Nd-glass, which is less prone to thermal explosion. The mechanical strength of N_{10} glass can be substantially increased by subjecting it to ion exchange and then chemically treating the surfaces so as to generate suitable inherent

stresses. As a result, it became possible to use N_{10} ($=N_{010}$) glass elements for repetition rates of up to 1-5 Hz.

During the last decade, we have focused our attention on the spectral, lasing, physical and physicochemical properties of the Nd-doped silicate laser glasses tested in the earlier experiments (cf. the Appendix). Five of these glasses (N_{03}, N_{07}, N_{08}, N_{09}, N_{010}) were developed on a larger scale (production quantities increased to over 100 liters) and larger specimens were produced. These Nd-doped silicate glasses for the most part included the main types of Nd-glass currently available on the international market.

During the next 10 years, the development of laser glasses will be closely coordinated with the development of high-power solid-state lasers. Nonlinear optical effects such as self-focusing, electrostriction, etc., are the principal factors responsible for damage to glasses in intense short-pulse lasers. The nonlinear dependence of the refractive index must be suppressed if the damage resistance of the laser glasses is to be improved. As the periods of the pumping pulses have become shorter, it has become necessary to increase the stimulated emission cross sections of laser glasses in order to increase the laser gain. Phosphate and fluorophosphate glasses meet these requirements; moreover, since their CTE is also lower than for silicate glasses, they can be used to reduce pump-induced thermal distortions.

Basing ourselves on previous work[8] carried out on phosphate and fluorophosphate optical glasses, we set out to investigate the spectral and luminescence properties of these two types of Nd-glasses; we also studied their thermal and chemical stability and the influence of hydroxyl groups on the luminescence and lasing properties. The N_{21} and N_{24} Nd-doped phosphate glasses[9] were developed and perfected using a new glass-manufacturing technique; N_{21} glass rods and plates of diameter 70 and 300 mm, respectively, can be produced. Fluorophosphate glasses have nonlinear refractive indices and thermo-optical coefficients which are even lower than for the phosphate glasses, in addition to higher luminescence quantum efficiencies; unfortunately, contamination by platinum and gold is a problem, the fluorophosphate crystals tend to break apart and separate, and the components in the glass melt volatilize at different rates,[10] so that technical difficulties preclude the practical use of this glass, even though finished specimens are available both in China and abroad. Table 1 lists the spectral, laser and physicochemical properties for fluorophosphate Nd-doped glass and two of the phosphate glasses described above.

2. Improvements in the Manufacturing of Neodymium Glasses

Compared with optical glasses, Nd-glasses require materials of greater purity and higher optical homogeneity; glasses of quality high enough for practical applications can be fabricated only if these requirements are fully satisfied throughout the fabrication process. Since 1964 we have been carrying out studies on smelting processes for Nd-doped silicate glasses in conjunction with workers at the Xinhu glass plant in Shanghai.

We first studied Nd glasses smelted in a platinum crucible in a resistance furnace. The laser output power from Nd-glass elements was increased rapidly,

Table 1. Properties of Neodymium-doped Phosphate and Fluorophosphate Glasses

No.	Property	Phosphate glass N_{2112}	Phosphate glass N_{2412}	Fluorophosphate glass LFP 2 percent Nd_2O
1.	Wavelength of fluorescence centers (μm)	1.054	1.054	1.053
2.	Halfwidth of fluorescence line (Å)	265	255	262
3.	Fluorescence lifetime (μsec)	350	310	405
4.	Stimulated emission cross section ($x10^{-20}$ cm^2)	3.5	4.0	2.838
5.	Fluorescence molecular branching ratio ($\beta_{1.06}$)	0.52	0.52	0.51
6.	Loss coefficient at 1.06 μm ($x10^{-3}cm^{-1}$)	1.5	1.5	>5
7.	Lasing efficiency* (6 x 150 mm element)	1.8	1.5	<1
8.	Wavelength of lasing centers (Å)	10541.39	--	10532.05
9.	Laser linewidth (Å)	34	--	21
10.	Density (g/cm^3)	3.38	2.95	3.52
11.	Refractive index	1.574	1.543	1.4805
12.	Abbe number	64.5	66.6	83.9
13.	Coefficient of thermal expansion, CTE ($x10^{-7}$/°C)	117	156	157
14.	Temperature coefficient of the refractive index ($x10^{-7}$/°C)	-53	--	-79
15.	Thermo-optical coefficient ($x10^{-7}$/°C)	7.1	--	-10
16.	Thermo-optical coefficient of stress ($x10^{-7}$/°C)	7	--	7
17.	Thermo-optical coefficient of birefringence (10^{-7}/°C)	4	--	3
18.	Transition temperature (°C)	510	370	420
19.	Deformation temperature (°C)	535	410	465
20.	Elastic modulus (kg/mm^2)	5550	5370	8259
21.	Shearing modulus (kg/mm^2)	2200	2150	3210
22.	Poisson ratio	0.26	0.25	0.28
23.	Nonlinear refractive index (10^{-13} esu)	1.3	1.2	0.685

* The two ends of the element had reflectivities of 99 percent and 50 percent.

but during this process the performance of the glass elements was found to deteriorate. Examination revealed that platinum particles present in the glass were primarily responsible for the degradation. We discovered that Nd-glass devoid of platinum impurity is much more resistant to laser-induced damage. We therefore modified the growth process as described below in order to eliminate platinum particles from the glass.

The first modification that we tried was to use a ceramic crucible, which necessitated a search for refractory materials (including the crucible walls and the agitating propellers), which had to contain less than 0.1 percent of undesirable impurities such as iron, be more resistant to corrosion by the molten glass, and be capable of withstanding high thermal loads. We tested various crucible materials and experimented with acidification processes using natural clay minerals to eliminate iron impurities. We also found some new, highly pure materials which after concentration contained less than 0.1 percent iron; after the addition of suitable fluxes we were able to smelt Nd-doped silicate glasses in a 100+ liter crucible made from pulverized material.

However, impurity elimination using natural materials is of only limited utility and is not capable of solving the problem of cutting optical losses in Nd-glasses on a large scale. In order to come up with purer ceramic materials, we therefore studied the properties of synthetic oxides.[11-13] These studies led to the synthesis of corundum materials which we used to fabricate large propellers for agitating the glass melts. Production in batch quantities was commenced, and it was found that the glass was more homogeneous and contained far less iron impurity than had been the case when natural clay agitating blades had been used. We obtained good results by synthesizing mullite materials for coating the lining of the crucibles.

Whenever glass is prepared in all-ceramic crucibles, the crucible walls are inevitably corroded by the melt with the result that the glass tends to contain cracks, gas bubbles, inclusions, and other types of defects. For many years we studied ways of eliminating inclusions and streaking in Nd glass during agitation of the melt.[14,15] Effective methods include reducing the melt temperature, agitating the mixture at lower temperatures and velocities, etc.

The other approach that we tried was to eliminate the platinum impurities by using a protective atmosphere. That is, we avoided entry of oxidized platinum into the glass either by applying a protective coating to the crucible walls or by preparing the glass in a platinum crucible in a neutral or reducing atmosphere. After the platinum was eliminated, the Nd glass was somewhat more resistant to laser-induced damage.[16] We also did experiments on radio-frequency (rf) smelting of naturally occurring laser glasses,[17] which showed that corrosion can be decreased by heating the glass in a 20 MHz electromagnetic field (heat dissipation in the glass, which is a dielectric, and eddy currents cause heating which melt the glass).

After the above improvements had been made, the iron content of Nd-doped silicate glass prepared in platinum crucibles was decreased to roughly 1 part in 10^5 and the optical losses at $\lambda = 1.06$ μm were cut to roughly 0.1 percent/cm;

Table 2. Comparison of Glasses Manufactured by Various Nations

Country	Glass	How manufactured	Light absorp. coefficient percent cm^{-1}	Optical homogeneity Δn (ϕ mm)	Threshold intesity for laser damage J/m (30 nsec)	Laser properties: Rod dimension (mm)	Laser properties: Reflectivity of output end	Laser properties: Efficiency percent	Laser properties: Grad. %	Material source, date
China	N_{0330}	pt crucible	0.1~0.2			$\phi 8 \times 81$	40	1.2	4	Our measurements, 1973
United States	ED-2	pt elim. process	0.3		40(5 breakdown pts/L)	$\phi 6 \times 75$	70	0.9	—	[51], 1972
Japan	LSG-91	"	0.1		28	$\phi 6 \times 75$	70	1.0	—	[51], 1972
West Germany	LG-55	ceramic crucible	0.5			$\phi 8 \times 79$	40	0.7	1.2	Our measurements, 1973
USSR	KGSS -46	—	0.15			$\phi 8 \times 80$	—	0.7~0.8	—	[52], 1969
China	N_{0330}	pt crucible	0.2	$<1 \times 10^{-6}$ (ϕ 50)		$\phi 14 \times 180$	30	2.0	—	Our measurements, 1968
Japan	LCG-11	pt elim. process	0.1~0.2	$\pm 5 \times 10^{-6}$ (ϕ 50)	28	$\phi 10 \times 160$	60	1.1	1.52	Product catalog, 1971
Japan	LSG-91	"	0.1		28	$\phi 10 \times 160$	60	—	2.0	[51], 1972
West Germany	LG-630	pt crucible	0.1~0.2	$\pm 2 \times 10^{-6}$ (ϕ 50)	—	$\phi 12 \times 170$	65	1.5	—	Product catalog, 1970
USSR	LGS -28-2	—	0.1		20	$\phi 10 \times 130$	—	1.2	—	Exhibition brochure, 1971
USSR	LGS -41	—	0.14		—	$\phi 10 \times 130$	—	2.0	—	" " "
Great Britain	LN-6	ceramic tank-shaped furnace	>1		—	$\phi 12 \times 165$	30	0.9	—	Our measurements, 1965
China	N_{0330}	pt crucible	0.1			$\phi 16 \times 500$	20	5~5.5	—	Our measurements, 1972
China	N_{0730}	ceramic crucible	0.2	5×10^{-6} (ϕ 50)		$\phi 16 \times 500$	20	4.5	—	Our measurements, 1972
United States	ED-2	pt elim. process	0.3		40	$\phi 19 \times 510$	—	5.5	—	Product catalog, 1971

for N_{0330} glass, the laser efficiency in the free-running mode approached 6 percent for glass rods measuring 16 by 500 mm. When ceramic crucibles were used, the iron content was two parts per 10^5, the optical losses were $\approx$ 0.2 percent/cm, and the lasing efficiency reached 4 percent in 16 x 500 mm glass rods. Table 2 compares the optical quality and laser properties of glasses manufactured in China and abroad, from which we see that our experimental products compare favorably enough with commercial glasses manufactured abroad.

Because phosphate and fluorophosphate glasses vigorously attack refractory ceramic materials, the latter cannot be employed in the manufacture of Nd-doped phosphate and fluorophosphate laser glasses. Other disadvantages of these glasses include their friability and their low viscosity during the pouring and forming stage, which makes it difficult to obtain homogeneous specimens. After many years of research, we succeeded in preparing Nd-doped phosphate glass by smelting the mixtures in a protective atmosphere using platinum crucibles and shaping the glass by pouring it through funnels.[18,19] Phosphate glasses absorb water readily, and hydroxyl groups effectively quench the fluorescence from neodymium ions; for this reason, special techniques for eliminating water during the smelting process are also required.[20,21] It is currently possible to fabricate large, high-quality Nd-doped phosphate glass samples with lasing efficiencies approaching 1.3 percent (6 x 100 mm glass rod, free-running mode) with short-pulse small-signal gains of 0.16/cm. For a laser with active element consisting of a glass plate 200 mm in diameter the gain is equal to 0.048/cm (after parasitic oscillations have been suppressed).

3. Measurements of Laser Properties and Tests of Glass Quality

More than 10 years ago we systematically developed methods for measuring and calculating the spectral and emissive properties of laser optical glasses (such as the fluorescence energy levels, the transition probabilities for metastable radiative and nonradiative transitions, the quantum efficiency, and the fluorescence branching ratios).[22] Table 3 lists the energy levels for the $^4F_{3/2}$ and $^4I_{9/2}$ responsible for fluorescence of Nd^{+3} ions and various fluorescence transitions $^4F_{3/2} \rightarrow {}^4I_{9/2}$ for some of the neodymium glasses manufactured in China. Table 4 in the Appendix lists the experimental spectral parameters for Chinese-produced Nd glasses.

For many meters we have been concerned with the problem of thermal distortion of Nd glass induced by optical pumping and have attempted to find the thermal distortion parameters and certain others, such as the temperature coefficient β of the refractive index, the thermo-optical stress coefficient P, the birefringence stress coefficient Q, and the thermo-optical coefficient W associated with nonthermal stresses, and their relationships. We also made theoretical predictions which were confirmed experimentally.[23] Precise measurement apparatus and methods were established in Reference 24 to measure these thermo-optical coefficients, and the dynamic pump-induced thermal distortions were measured for Nd glass in Reference 25. This work provided the foundation for improving the glass composition and quality so as to eliminate or reduce thermal distortion.

Table 3. Fluorescence Sublevels (a) and $^4F_{3/2} \rightarrow {}^4I_{9/2}$ Fluorescence Transitions (b) for Four Nd-doped Silicate Glasses (Unit: cm^{-1})

Glass type		N_{0712}	N_{0312}	N_{0912}	N_{0812}
a) $^4I_{9/2}$	1	0	0	0	0
	2	78	84	79	78
	3	176	180	188	180
	4	262	278	279	280
	5	500	497	498	510
$^4F_{3/2}$	upper	11410	11403	11403	11403
	lower	11580	11577	11578	11572

Glass / Peak / Transition	N_{0712}		N_{0312}		N_{0912}		N_{0812}	
	λ (Å)	ν (cm^{-1})	λ (Å)	ν (cm^{-1})	λ (Å)	ν (cm^{-1})	λ (Å)	ν (cm^{-1})
$^4F_{3/2} \rightarrow {}^4I_{9/2}$								
b) upper →1	8635	11580	8637	11577	8637	11578	8642	11572
→2	8695	11502	8700	11494	8705	11488	8700	11494
→3	8770	11403	8775	11397	8780	11390	8780	11390
→4	8835	11319	8850	11299	8850	11299	8855	11292
→5	9025	11080	9025	11080	9025	11080	9040	11062
lower →1	8765	11410	8770	11403	8770	11403	8770	11403
→2	8825	11332	8835	11319	8830	11325	8830	11325
→3	8900	11236	8910	11222	8915	11215	8910	11223
→4	8970	11148	8990	11124	8990	11124	8990	11123
→5	9165	10910	9170	10905	9170	10905	9180	10893

Damage to Nd glass elements by intense laser radiation is a serious ongoing problem which we studied experimentally by employing multipulse high-energy and single-pulse high-power lasers. Damage both inside and outside the laser cavity was investigated, damage thresholds were determined for various types of glass, and the specific features of damage development were observed. We paid particular attention to measurements of the nonlinear refractive index, which was determined in several experiments under conditions of self-focusing,[26] self-induced polarization changes,[27] light-induced birefringence,[28] and interference.[29]

The most important characteristic of large laser glass specimens is their optical homogeneity, which determines the optical quality. We set up numerous experiments to study the optical homogeneity by the interference, star point, projection, and imaging methods, and an overall assessment of the results was discussed in Reference 30. Subsequent tests of glass homogeneity based on holographic interferometry were then developed for carrying out the measurements quickly,[31] as well as for analyzing stripes and gas bubbles in glasses.[32] At the same time, improvements were made in the methods and apparatus for measuring the light absorption at wavelength 1.06 μm by glasses and for determining the residual stresses in glass rods and plates. Much information has been gathered in the numerous experiments which have been routinely carried out over the last 10-odd years. These experimental results indicated from the first that the lasing efficiency is determined by the concentration of ferrite ions in the glass and by the absorption coefficient. We also analyzed relationships between these physical characteristics and found that the optical homogeneity of glass rods greatly influences the directional properties of the laser beam (this is particularly true for closely spaced stripes and physical inhomogeneities). We also comprehensively investigated and analyzed instability of the laser output in Nd glass elements subjected to repeated pumping and found that in addition to generating color centers, irradiation by ultraviolet light also stimulated redox interaction among inclusions in the glass (the valance number of the ions is altered); as a result, Fe^{3+} is reduced to Fe^{2+}.

In order to fully assess the properties of laser glasses, suitable equipment and methods must be established for measuring the relevant physical parameters such as the refractive index at ultraviolet and infrared wavelengths,[33] the optical stress constants, and the elastic moduli.[34] Methods for calculating the physical properties of glasses intimately related to the laser properties have also been developed.[35]

4. Some Basic Investigations of Laser Glasses

The spectral characteristics and structural states of various rare-earth ion-doped inorganic glasses were investigated as far back as 1963,[36] where we employed ligand field theory in order to account for the experimental findings. In our later work we concentrated on studying the spectral and luminescence properties of neodymium-doped glasses. We were particularly interested in how these properties are influenced by the microscopic and submicroscopic structure of the underlying glass matrix.[37] Our investigations began with silicate matrix glasses but then expanded to include other inorganic glasses

(borate, phosphate, germanate, tellurate, and fluorophosphate and other fluoridated glasses). The glass matrix interacts with the laser-active ions in the glass and thereby alters the lasing properties. For example, the electrostatic interaction between the Nd^{3+} ions and the ligand field gives rise to a splitting in the spectral lines (or energy levels). We measured the changes in the splitting Δ of the multiplets for the $^4I_{9/2}$ ground state and the $^4I_{11/2}$ final state of Nd^{3+} in glasses and inorganic crystals. The measurements showed that Δ is related to the interaction F between the Nd^{3+} ions and the neighboring ligands (anions), where F is given by the simple expression $F = 3z/a^2$; here z is the valence of the anion, and a is the sum of the Nd^{3+} and ligand ion radii. The splitting Δ increases with F. Thus for example, if the matrix contains anionic clusters such as SiO_4^{-4} or PO_4^{-3}, Δ drops as the interaction of Nd^{3+} with the ligands becomes weaker. As the interaction of the central cation in an $[RO_x]$ cluster with divalent O^{2-} anions becomes stronger the O^{2-}-Nd^{3+} interaction becomes correspondingly weaker, so that Δ falls off as f' increases, where $F' = 2z'/a^2$, cf. Figure 1 (here z' is the valence of the central cation). Glass matrices are covalent rather than ionic compounds and unlike ionic crystals their main effect on the laser-active ions is to polarize them. This effect was first observed as a shift in the spectral lines (cf. Figure 2), which we interpreted as a consequence of changes in the differences Δx of the electronegativities of the anions and cations.[38] The effects of polarization on the transition probabilities for the laser transitions are even more pronounced. Shifts in the Nd^{3+} energy levels in inorganic glasses were investigated in Reference 39; in Reference 40 the transition probabilities were studied for 10 different radiative and nonradiative transitions in Nd-doped glasses, and the stimulated emission cross sections, quantum efficiencies, and other properties were determined; the results are listed in Table 4.[40] The matrix was found to have a much greater influence on the probabilities for the nonradiative transitions than for the aradiative ones. The experiments demonstrated that phonon-assisted relaxation processes and resonance shifts are responsible for energy transfer for the nonradiative transition in inorganic glasses containing Nd^{3+} ions or other rare-earth or transition-element ions interacting with the matrix. The well-known multiphonon model was employed in References 41 and 42 to analyze energy transfer between Nd^{3+} and anions such as OH^- or O^{2-} ligands. Unfortunately, the complexity of the phonon modes in inorganic glasses made it impossible to obtain a satisfactory description of the experimental findings, which may involve a mechanism of energy transfer among internal molecular states. This experimental work is still in progress.

Glasses which provide tunable lasing and glasses which lase at visible or infrared wavelengths are the most important types for the development of new laser glasses. This motivated further spectral and luminescence studies for glasses doped with the ions of elements in the transition, actinide, and rare-earth families in References 43-45 and 53, where paramagnetic resonance, stimulated fluorescence, and time-resolved spectra were recorded for glasses doped with Cr^{3+}, Mo^{3+}, Mn^{2+}, Co^{2+}, Ni^{2+}, UO_2^{2+}, and other ions. The influence of Ce^{3+} on energy transfer between Tb^{3+}, Tm^{3+}, Er^{3+}, and Nd^{3+}-Yb^{3+} was also studied in Reference 46.

Table 4. Luminescence Properties of Nd^{3+} in Inorganic Glasses

No.	Glass system	τ_m (sec)	$A_r^{1.06}$ (sec^-)		ΣA_r (sec^-)		ΣA_{nr} (sec^-)		η total		$\sigma_p^{1.06}, \times 10^{-20}$ (cm)	
			Meas.	Calculated	Meas.	Calculated	Meas.	Calculated	Meas.	Calculated	Meas.	Calculated
1	Borate	90	1220	1284	2416	2666	8695	8445	0.22	0.24	2.35	2.46
2	Silicate	510	856	907	1793	1849	168	112	0.91	0.94	1.90	2.01
3	Germanate	370	1152	1118	2425	2356	278	346	0.90	0.87	2.51	2.43
4	Tellurate	230	2914	2574	5950	5272	~0	~0	~1.0	~1.0	5.05	4.46
5	Phosphate	280	1405	1238	2831	2360	740	1210	0.79	0.67	4.46	3.92
6	Alumate	200	1728	2164	4028	4645	972	355	0.81	0.93	2.9	3.60
7	Aluminum Silicate	200	1170	1499	2704	3123	2296	1877	0.54	0.62	1.9	2.4
8	Gallium Silicate	350	1147	1258	2298	2579	559	278	0.80	0.90	1.8	2.0
9	Fluoro-phosphate	475	1007	889	1890	1811	215	294	0.90	0.86	2.5	2.2
10	Beryllium fluorate	600	700	697	1290	1285	380	382	0.77	0.77	2.15	2.15

Note: ΣA_{nr} is the nonradiative transition probability; ΣA_r is the radiative transition probability; η is the quantum efficiency; σ_p is the stimulated emission cross-section.

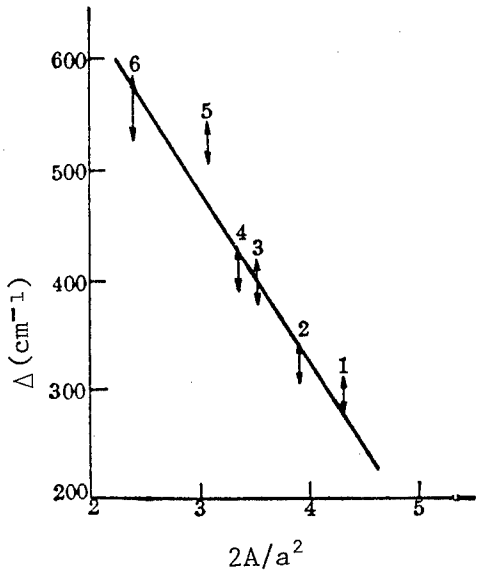


Figure 1. Splitting of the $^4I_{9/2}$ Terms as a Function of the Interaction Strength F Between the Cations and the Oxygen Anion Clusters

1. Phosphate
2. Tungsten, molybdenum
3. Potassium
4. Vanadium
5. Silicon
6. Boron
7. Niobium, tantalum acid salts

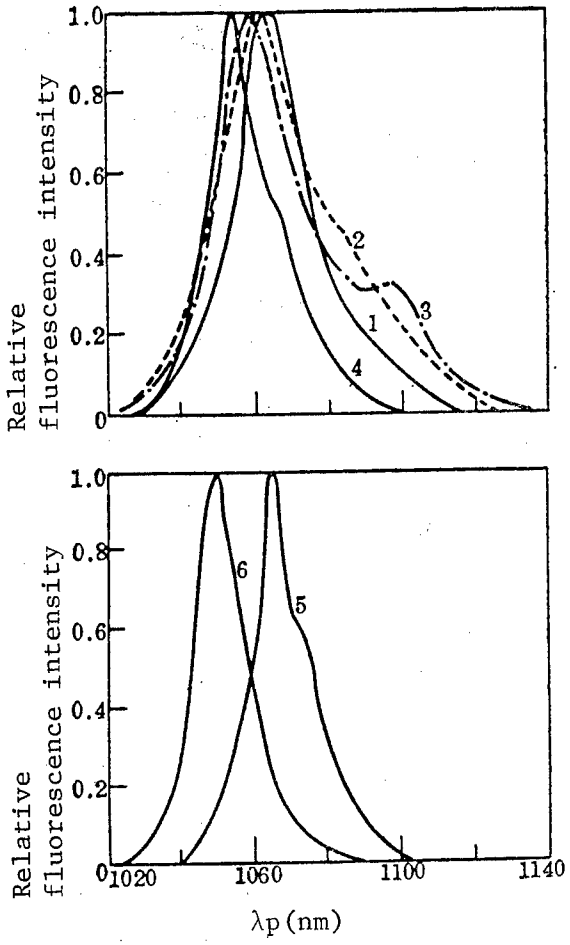


Figure 2. Fluorescence Spectra for Several Nd-doped Glasses

1. Tellurate
2. Borate
3. Silicate
4. Phosphate
5. Chloride
6. Fluoride

The interaction of intense laser radiation with glassy media has also been investigated quite systematically. The initial work stressed the precise observation and quantitative measurement of the following three phenomena: 1) Beam dispersion, i.e., thermal distortions in the glass induced by natural laser oscillations; 2) self-focusing associated with short laser pulses; 3) laser-induced damage. We concluded on the basis of the experiments described respectively by the quantities $n_2(T)$, $n_2(S)$, and $n_2(3)$] are responsible for the beam-glass interaction.[47] We developed a new method for calculating the three nonlinear refractive indices precisely from already known physical parameters of the glasses.[48,49] Table 5 lists and compares the nonlinear refractive index $n_2(E)$ for several glasses; the values were measured by recording the threshold for self-focusing (SF), determining the self-induced polarization change (SIPC), and by measuring the light-induced birefringence; the calculated values are also shown for comparison. The laser pulse length determines which of the three nonlinear optical effects will dominate. Table 6 lists the nonlinear refractive indices for N_{03} laser glass for three different pulse lengths, from which we see that thermal effects dominate in the beam-glass interaction for continuous or millisecond laser pulses, while the nonlinear polarization is the dominant factor for subnanosecond pulses. We used these results to plot the laser-induced nonlinear optical effects as a function of the physical characteristics of the glasses. Figure 3 shows the damage thresholds for optical and laser glasses as functions of $n_2(E)$ for nanosecond laser pulses. Figure 4 plots the thermal dispersion $\Delta\theta/E_A$ induced in glasses by millisecond laser pulses as a function of $n_2(T)$ [here $\Delta\theta$ is the scattering angle of the output laser beam and E_A is the specific glass absorption (per unit volume)].

Table 5. Experimental and Calculated Values for the Nonlinear Refractive Index of Some Optical and Laser Glasses

Glass		Measured values (10^{-13}, esu)			Calculated $n_2(E)$ (10^{-13}, esu)
		SF	SIPC	LIB	
Optical glasses	ZF-7	6.4	7.5	8.3	9.0
	BaF-2	4.1	3.0	3.0	3.6
	QK-3	1.3	—	—	1.2
Laser glasses	N_{0312}	1.9	2.0	2.0	1.7
	N_{0812}	1.6	1.8	2.0	1.9
	N_{1012}	1.6	1.8	2.0	1.7
	N_{2112}	1.3	2.0	1.2	1.5

Table 6. Nonlinear Refractive Index for N_{03} Laser Glass for Different Laser Pulse Lengths

Nonlinear effect	Response time (sec)	Nonlinear refractive index (cm^2/W)		
		msec pulses	μsec pulses	nsec pulses
Thermal blooming	$10^{-6}\sim10^{-7}$	6×10^{-12}	6×10^{-15}	—
Electro-striction effect	$10^{-7}\sim10^{-8}$	1.06×10^{-16}	1.06×10^{-16}	1.06×10^{-16}
Nonlinear polarization effect	$10^{-15}\sim10^{-16}$	0.92×10^{-15}	0.92×10^{-15}	0.92×10^{-15}

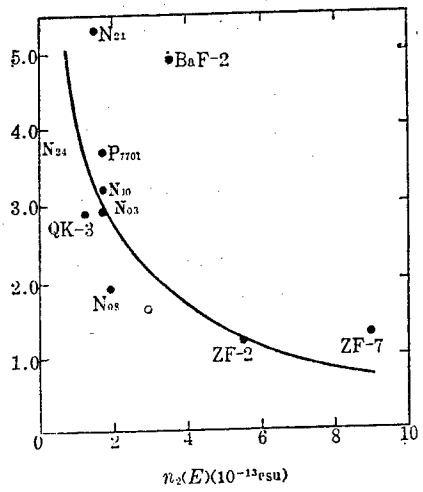


Figure 3. Laser-induced Damage Threshold in Glass as a Function of $n_2(E)$

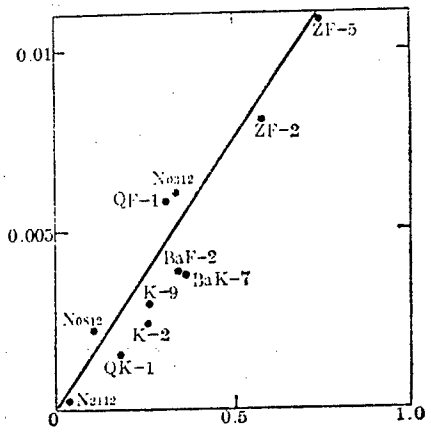


Figure 4. Thermal Blooming in Glasses as a Function of $n_2(T)$

As lasing has progressed toward shorter wavelengths, laser-induced damage and dispersion associated with the nonlinear refractive index at different wavelengths have become increasingly important, and our experimental and theoretical work along these lines is continuing.

Some of the material in this article has been taken from Volumes 2 (1974) and 8 (1980) published by the Chinese Academy of Sciences and entitled "Shanghai Institute of Optics and Fine Mechanics, Research Reports on Neodymium Glasses" and "Laser Materials and Elements," respectively.

Table 1. Physical and Technological Characteristics

Type	Physical properties						Technological properties		
	Density (g/cm^3)	Micro-hardness (kg/mm^2)	Mechanical strength (kg/mm^2)	Elastic modulus ($10^3 kg/cm^2$)	Thermal exp. coeff. 10^{-7} °C^{-1}		Trans. temp. T_g(°C)	Soft-ening temp. T_f(°C)	(1) (°C)
					15°C~200°C	15°C~T_g			
N_{0112}	2.90	560	9.7	679	90	104	500	590	1400
N_{0212}	2.87	560	9.0	720	83	91	560	630	1380
N_{0312}	2.51	606	11.8	759	80	88	590	660	1430
N_{0412}	2.49	615	9.4	727	52	57	590	670	1680
N_{0612}	2.52	623	10.4	810	87	98	555	610	1270
N_{0712}	2.52	557	9.1	647	89	96	495	560	1470
N_{0812}	2.80	551	9.1	647	107	120	545	600	1440
N_{0912}	2.50	533	10.2	687	87	93	620	680	1450
N_{1024}	2.52	585	8.9	750	89	100	525	585	1420

(1) Temperature corresponding to a viscosity of 100 poise

Table 2. Refractive Index and Dispersion

Type	Crucible type	Refractive indices							
		n_C	n_D	n_e	n_F	$n_F - n_C$	ν	$n_{1.06}$	
								exp.	calculated
N_{0112}	C72-13	1.53965	1.5424		1.54898	0.00933	58.14	1.5316	1.5315
N_{0212}	E70-05	1.53860	1.5413		1.54768	0.00908	59.5		1.5307
N_{0312}	D904	1.51969	1.5224	1.52446	1.52843	0.00874	59.8	1.5122	1.5122
N_{0412}	C7215	1.49969	1.5021		1.50774	0.00805	62.5	1.4923	1.4927
N_{0512}	E70-13	1.51725	1.5197		1.52549	0.00824	63.1	1.5136	1.5100
N_{0712}	D865	1.50290	1.5054	1.50746	1.51134	0.00844	59.9	1.4953	1.4955
N_{0812}	C7133	1.53271	1.5354		1.54191	0.00920	58.2	1.5248	1.5246
N_{0912}	D926	1.51502	1.5176	1.51972	1.52363	0.00861	60.1	1.5076	1.5075
N_{1024}	B71-07	1.51455	1.5171		1.52335	0.00880	58.8	1.5067	1.5068

Table 3. Thermo-optical Characteristics

Type	$\beta(10^{-6}, °C^{-1})$	$W(10^{-6}, °C^{-1})$	$P(10^{-6}, °C^{-1})$	$Q(10^{-6}, °C^{-1})$	Stress-optic constants ($10^{-6}cm^2/kg$)	
					$-C_1$	$-C_2$
N_{01}	−0.86	4	5.0	0.8	0.15	0.38
N_{02}	0.13	4.6	4.9	1.0	0.12	0.42
N_{03}	1.64	5.8	4.0	0.9	0.11	0.36
N_{04}	4.17	6.8	2.7	0.8	0.08	0.37
N_{06}	−0.20	4.3	4.9	1.0	0.10	0.35
N_{07}	0.20	4.5	4.0	1.1	0.11	0.40
N_{08}	−3.20	2.5	5.5	1.0	0.09	0.38
N_{09}	0.12	4.6	4.2	1.0	0.11	0.37
N_{10}	0.80	5.4	4.6	1.0	0.09	0.35

Table 4. Spectral Parameters

Type	Main components	(1)			$A_{[0.88]}$	$A_{[1.06]}$	$A_{[1.35]}$	$\sum_i A_{ri}$	τ	$\sum_n A_{nj}$	η	$\Delta\lambda^a_{[0.88]}$	$\Delta\lambda^F_{[1.06]}$	$\sigma^a_{p[0.88]}$ ($\times 10^{-20}$	$\sigma^F_{p[1.06]}$ ($\times 10^{-20}$
		$\beta_{0.88}$	$\beta_{1.06}$	$\beta_{1.35}$	(2)	(2)	(2)	(2)	(3)	(2)	(%)	Å	Å	cm^2)	cm^2)
N_{0112}	SiO_2–K_2O–BaO	40	50	10	410	513	100	1024	600	640	61	220	380	0.26	1.00
N_{0212}	SiO_2–B_2O_3–K_2O–BaO	41	49	10	427	513	100	1038	620	575	64	230	360	0.26	1.04
N_{0312}	SiO_2–Na_2O–K_2O–CaO	38	53	9	520	719	124	1364	590	331	81	230	395	0.32	1.35
N_{0412}	SiO_2–K_2O–CaO	41	45	14	477	524	163	1159	680	312	79	260	370	0.26	1.05
N_{0612}	SiO_2–B_2O_3–NaO–K_2O	45	47	9	405	424	81	904	680	567	62	260	360	0.22	0.87
N_{0712}	SiO_2–NaO–K_2O	46	46	8	330	330	57	725	890	399	65	250	335	0.19	0.73
N_{0812}	SiO_2–BaO–K_2O	37	52	11	426	600	127	1156	760	160	88	270	400	0.23	1.11
N_{0912}	SiO_2–CaO–K_2O	42	48	9	405	460	87	959	750	374	72	250	360	0.23	0.95
N_{1024}	SiO_2–CaO–N_2O	35	54	12	470	725	161	1355	510	606	69	240	370	0.29	1.45

(1) Fluorescence branching ratio (2) (sec^{-1}) (3) (μsec)

Table 5. Laser Characteristics

Type	Light absorption at λ=1.06μm (percent/cm)	Lasing * efficiency (%) for 16x500mm glass rods	Wavelength at center of laser line (Å)	Laser linewidth (Å)
N_{0112}	0.2	2.4	—	—
N_{0212}	0.1	3.0	—	—
N_{0312}	0.1	4.0	10624.53	94
N_{0412}	0.16	3.8	10613.21	90
N_{0612}	0.29	2.2	10604.27	124
N_{0712}	0.12	3.5	10584.14	62
N_{0812}	0.27	2.7	10597.89	112
N_{0912}	0.10	3.8	10608.61	109
N_{1024}	0.22	3.5	10611.39	91

*For rod ends with reflectivities of 100 percent and 50 percent, 3 msec light pulses, output energy 10^4 J.

REFERENCES

1. Gan Fuxi, "Analysis of materials using an optical-quantum mechanical amplifier with inorganic glass components," Proc. Inst. of Optics and Fine Mechanics, Chinese Academy of Sciences, Vol 1 pp 105-115 (1963).

2. E. Snitzer, PHYS. REV. LETT., 7, 444 (1961).

3. Gun Fuxi, Jiang Zhonghong and Cai Yingshi, KEXUE TONGBAO [in Chinese], No 1, 54 (1964).

4. Gan Fuxi, et al., KEXUE TONGBAO [in Chinese], No 11, 1012 (1965).

5. Cai Yingshi, Li Xishan and Gan Fuxi, KEXUE TONGBAO [in Chinese], No 12, 1112 (1964).

6. Shanghai Institute of Optics and Mechanics Research Report No 1, NEODYMIUM GLASS LASERS [in Chinese] p 37.

7. Wang Guisheng, JIGUANG [in Chinese], 8, No 10, 64 (1981).

8. Gan Fuxi, et al., OPTICAL GLASSES [in Chinese], Science Publishers (1964).

9. Jiang Zhonghong, Song Xiuyu and Zhang Jinzhou, GUISUANYAN [in Chinese] 3, No 3, 1 (1980).

10. Zhuo Dunshui, Xu Wenjuan and Jiang Yasi, ZHONGGUO JIGUANG [in Chinese] 10, No 10, 726 (1983).

11. Work Group on Nd-Glass Crucibles, "Glasses and Enamels," No 4, 1 (1974) [in Chinese].

12. Wu Zhengliang, Jiang Yasi and Qian Zhengying, GUANGXUE CAILIAO [in Chinese], No 4, 84 (1980).

13. Fan Guangtang and Jian Yasi, BOLI YU TANGCI [in Chinese], No 4, 13 (1983).

14. Yang Peihong, et al., GUANGXUE CAILIAO [in Chinese], No 3, 1 (1979).

15. Xiao Bingrong and Yu Sen, GUANGXUE CAILIAO [in Chinese] No 1, 29 (1980).

16. Mao Xilai, Lu Poyang and Qi Genfu, GUANGXUE CAILIAO [in Chinese], No 3, 42 (1979).

17. Sun Hongwei, Jiang Yasi and Hu Xinyuan, GUISUANYAN XUEBAO [in Chinese] 7, No 3, 255 (1979).

18. Yu Sen and Li Jie, GUANGXUE CAILIAO [in Chinese] Nos 2-3, 66 (1982).

19. Zhang Junzhou and Jiang Yasi, GUISUANYAN TONGBAO [in Chinese] 3, No 3, 1 (1983).

20. Yu Sen and Song Xiuyu, GUANGXUE CAILIAO [in Chinese], No 1, 15 (1981).

21. Jiang Zonghong, Song Xiuyu and Yu Sen, GUANGXUE CAILIAO [in Chinese], No 2, 3 (1982).

22. Chen Shuchun, Qi Zhanghong and Dai Fengmei, WULI XUEBAO [in Chinese] 29, No 1, 54 (1980).

23. Work Group on Thermal Distortions in Nd Glass, WULI XUEBAO [in Chinese] 27, No 1, 22 (1978).

24. Huang Guosong and Chen Shizheng, GUANGXUE CAILIAO [in Chinese] 2, No 4, 380 (1982).

25. Chen Zexing and Li Zhongya, GUANGXUE CAILIAO [in Chinese] 10, No 2, 832 (1983).

26. Deng He, Zhang Meizhen and Zheng Guizhen, JIGUANG [in Chinese] 6, No 1, 13,(1979).

27. Zhang Meizhen, Deng He and Li Chengfu, JIGUANG [in Chinese] 8, No 4, 22 (1981).

28. Deng He, Zhang Meizhen and Li Chengfu, JIGUANG [in Chinese] 8, No 11, 18 (1981).

29. Fu Wenbiao and Zheng Guizhen, JIGUANG [in Chinese] 8, No 4, 48 (1981).

30. Li Xishan, Jiang Anmin and Xia Qingsheng, GUISUANYAN XUEBAO 6, No 3, 149 (1978).

31. Li Xishan, Jiang Anmin and Xia Qingsheng, GUISUANYAN XUEBAO 8, No 3, 289 (1980).

32. Li Xishan, Jiang Anmin and Xia Qingsheng, JIGUANG [in Chinese] 7, No 10, 42 (1980).

33. Jiang Anmin, Xia Qingsheng and Li Xishan, GUISUANYAN XUEBAO [in Chinese] 7, No 4, 388 (1979); GUANGXUE CAILIAO [in Chinese] 2, No 3, 32 (1980).

34. Gan Fuxi, Lin Fengying and Gao Wenyan, GUISUANYAN XUEBAO [in Chinese] 6, No 4, 256 (1978).

35. Gan Fuxi, ZHONGGUO KEXUE [in Chinese] No 4, 351 (1974).

36. Gan Fuxi, Jiang Zhonghong and Cai Yingshi, KEXUE TONGBAO [in Chinese], No 9, 50 (1963); No 12, 41 (1963); No 1, 52 (1964).

37. Gan Fuxi, GUISUANYAN XUEBAO [in Chinese] 6, Nos 1-2, 40 (1978).

38. Gan Fuxi, HEBEI DAXUE XUEBAO [in Chinese] 2, No 2, 68 (1982); GUANGXUE JIXIE [in Chinese] No 3, 1 (1982).

39. Gan Fuxi, KEXUE TONGBAO [in Chinese] No 12, 723 (1978); No 2, 59 (1979).

40. Gan Fuxi, Chen Shuchun and Hu Hefang, ZHONGGUO KEXUE [in Chinese] No 3, 289 (1981).

41. Chen Shuchun and Dai Fengmei, ZHONGGUO JIGUANG [in Chinese] 30, No 5, 624 (1981).

42. Chen Shuchun, Song Xiuyu and Dai Fengmei, ZHONGGUO JIGUANG [in Chinese] 10, No 6, 366 (1983).

43. Gan Fuxi, Liu Huimin and Deng He, WULI XUEBAO [in Chinese] 31, No 3, 410 (1982); 31, No 3, 404 (1982).

44. Liu Huimin and Gan Fuxi, GUANGXUE XUEBAO [in Chinese] 2, No 5, 393 (1982); 2, No 6, 541 (1982).

45. Gan Fuxi and Liu Huimin, GUISUANYAN XUEBAO [in Chinese] 11, No 1, 49 (1983).

46. Zheng Zhanghong and Gan Fuxi, GUANGXUE YU XIANSHI [in Chinese], No 3, 1 (1983).

47. Deng He and Gan Fuxi, "Laser-induced damage in optical materials," in: Proc. NBS No 638, pp 568-578 (1981).

48. Gan Fuxi and Lin Fengying, JIGUANG [in Chinese] 6, No 4, 12 (1979).

49. Gan Fuxi and Lin Fengying, JIGUANG XUEBAO [in Chinese] 1, No 1, 75 (1981).

50. Deng He and Li Chengfu, GUANGXUE XUEBAO [in Chinese] 3, No 8, 766 (1983).

51. C. Yamanaka, in: Proc. Japan-U.S. Seminar "Laser Interaction With Matter," September, 1972.

52. E.I. Galant, et al., Opt.-Mekh. Prom. [in Russian], No 8, 33 (1969).

53. Chen Shuchun, Gan Fuxi and Dai Fengmei, GUANGXUE XUEBAO [in Chinese] 4, No 2, 107 (1984).

12617
CSO: 4008/46

RESEARCH PROGRESS ON LASER CRYSTALS IN CHINA

Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 11 No 8, 20 Aug 84 pp 460-463

[Article by Zhang Yingxia [7022 5391 0204] of the North China Research Institute of Electro-Optics]

[Text] During the 10th anniversary of the 1st issue of the CHINESE JOURNAL OF LASERS we enthusiastically reviewed the course of China's progress in laser science and technology. The Changchun Institute of Optics and Mechanics, the Suzhou Gem Plant, and other groups made pioneering contributions to the initiation in 1961 and subsequent development of the laser crystal industry in China. Current Chinese research on laser crystals is now quite extensive and involves more than 30 research teams with nearly 1,000 technicians and workers actively engaged in the study of more than 20 types of laser crystals. Neodymium-doped yttrium aluminum garnet (Nd:YAG) and ruby ($Cr:Al_2O_3$) lasers have been manufactured and are widely employed. There are several new and promising crystals now under study which will find applications, and both basic and exploratory research have given rise to new developments.

1. Laser Crystals With Rare-Earth Ions

A) Nd:YAG

China began growing YAG crystals in 1965, and lasing was first achieved in crystals grown from salt melts, which yielded Nd:YAG bars 50 mm long. Lasing from Nd:YAG crystals grown by the Czochralski method was achieved in 1967. This method, which rapidly became popular in China, employed graphite or tungsten heaters and resistively heated molybdenum crucibles to grow the crystals. The Southwest China Institute of Engineering Physics investigated the growth of unnucleated, dislocation-free Nd:YAG crystals on a horizontal interface under controlled conditions and made a series of technical innovations. The Sichuan China Optical Instrument Plant has recently been certified by technical authorities and is capable of producing homogeneous, high-quality crystals with reproducible properties (as little as 0.25 of an interference fringe per 25 mm). A continuing problem with the graphite resistive heater technique is that the grown crystals contain many scattering particles. The Shanghai College of Communications has succeeded in reducing the number of scattering particles to a certain extent by employing a controlled growth atmosphere.

After many years of technical improvements, irridium crucibles and inductive heaters can now be used to grow convex crystals of diameter 25 ~ 30 mm devoid of scattering particles by the Czochralski technique. Crystals 35 ~ 40 mm in diameter have been grown by the North China Research Institute of Electro-Optics. Laser rods measuring 9 x 75 mm and with 0.3 of an interference fringe /25 mm can now be used for selectable laser amplifiers. At present, the Jilin Laser Materials Plant is the largest industrial facility in China for the production of YAG laser elements; YAG laser production is also being greatly stepped up at the Liming Machinery Plant in Chengdu.

Whether the crystals are grown by the resistive or the inductive methods, their laser properties are significantly improved by high-temperature annealing, which indicates that oxide crystals can grow in nonreducing or inert atmospheres--oxygen ion vacancies and OH^- radicals are easily produced under these conditions. Annealing will alter the color of specific crystals which are contaminated by undesirable impurities or contain serious crystal defects; the light absorption and the scattering losses are also substantially increased. Because the results of annealing are highly dependent on the prior condition of the crystals, this method is not suitable for practical applications.

Chinese-produced Nd:YAG laser rods were tested on two occasions in the past under a unified system of procedures, and these tests have greatly stimulated exchanges of technical information and have improved crystal quality and led to the standardization and unification of measurement and test procedures. Continual progress has been made in selecting rods with the best laser properties, in developing antireflecting films to coat the ends of the rods, and in other areas. New techniques for ultrasonic selection of crystal blanks and simultaneous end-treatment, of large numbers of glass rods will shortly become available.

In their research on doubly doped Nd:Cr:YAG crystals, workers at the North China Research Institute of Electro-Optics discovered that in addition to its sensitizing effects, Cr^{3+} in Nd:YAG crystals can also decrease crystal distortion, increase the Nd^{3+} fluorescence lifetime, and improve crystal resistance to ultraviolet irradiation. Nd:Cr:YAG crystals have found application in medicine and are employed to rapidly punch holes in jewel bearings and to measure distances.

2. $YAlO_3$

$YAlO_3$ crystals were grown in 1971 and lasing was achieved in 1972. Because of its increased sensitivity to the initial quality of the materials and to any impurities that may be present, the atmospheres used to grow and anneal the $YAlO_3$ crystals have a great influence on the final quality, and graphite--molybdenum growth systems have gradually been optimized by a process of competitive elimination. Researchers at the Shanghai Institute of Optics and Fine Mechanics carried out fundamental work on the thermo-optical properties of $YAlO_3$ crystals, their transition cross sections, and their applications in lasers. The focus of most of the work on laser crystals shifted to YAG materials at the end of the 1970's; only the Fujian Material Structure Institute continued the older line of research. Nevertheless, much useful

information was gained regarding thermal effects in $YAlO_3$ and on the specific laser characteristics of this material. The output power for an Nd:Cr:$YAlO_3$ crystal oriented along the b axis is equal to 162 W for continuous lasing at λ = 1.079 μm; at λ = 1.34 μm, the corresponding figure is 20 W (both of these values compare favorably with recent results reported in the international literature). Er:$YAlO_3$ crystals were also grown and analyzed spectroscopically.

3. $LiYF_4$ (YLF)

The North China Research Institute of Electro-Optics began to produce YLF crystals in 1977 in order to meet the need for achieving lasing at new wavelengths. Various Czochralski growth techniques employing inert gas atmospheres and graphite boats were developed, and methods were found for overcoming crucial problems in crystal quality (oxygen present in the starting materials, loss of crystal transparency, twinning, scattering particles, etc.). Laser action at room temperature was achieved in Nd:YLF (λ = 1.047, 1.053, and 1.32 μm), Er: YLF (λ = 0.85 μm), αβ-YLF (λ = 2.06 μm), and other crystals. The output energy of a pulsed Nd:YLF laser can reach 838 mJ per pulse, and the angular efficiency is typically 1.51 percent (values as high as 1.73 percent have been reported). Mode-locking has been reported in Nd:YLF laser oscillators.

4. Self-excited Laser Crystals

The Shandong University workers and other groups have grown transparent NdP_5O_{14}, (Nd, La)P_5O_{14}, and $NdAl_3(BO_3)_4$ crystals from salt melts by using improved fluxes in a process in which powder crystals are rotated. The crystal diameters of up to 4 cm compare favorably with the best values reported abroad. Lasing was reported from xenon-flashlamp-pumped NdP_5O_{14} crystals in 1979, and these crystals are now employed in miniature laser ranging devices. Lasing has also been achieved in (Nd, La)P_5O_{14} and $NdAl_3(BO_3)_4$, which have properties superior to those of NdP_5O_{14}. Pulsed lasing at room temperature was reported in 1980 from small Nd:$GdAl_3(BO_3)_4$ crystals grown by the Fujian Material Structure Institute.

The Shanghai Institute of Optics and Fine Mechanics and the Shanghai Silicate Institute have manufactured $NdLiP_4O_{12}$ crystals for use as fiber-optical communication links, and fiber lasing has been achieved. In order to reduce the resonant losses in these types of crystals, the Shanghai Silicate Institute succeeded in changing the crystal composition to $Nd_{0.5}La_{0.5}LiP_4O_{12}$, which holds promise for reducing the lasing threshold.

Lasing at pulse repetition rates of 15 - 20 Hz has been achieved in NdP_5O_{14} laser glass rods manufactured by the Beijing Workers' Crystal Institute. These glass rods may prove useful in laser ranging devices and in medicine.

2. Transition-element Laser Crystals

A. Ruby (Cr:Al_2O_3)

The flame fusion method and thermal currents were investigated in the early 1960's, after which time research on ruby lasing was discontinued. In the

1970's, the Anhui Institute of Optics and Mechanics and the Suzhou Crystal Components Plant succeeded in growing homogeneous ruby crystals by the Czochralski method. With the collaboration of the Silicate Institute and the Institute of Optics and Fine Mechanics in Shanghai, the Laser Focus Institute improved the flame fusion technique to grow higher-quality crystals with laser efficiencies as high as 1.7 percent. The Anhui Institute of Optics and Mechanics and the Laser Focus Institute (which is one of China's principal suppliers) are now at work on new breakthroughs in the Czochralski growth process and are developing ruby rods for holographic applications.

B. Chrysoberyl ($Cr:BeAl_2O_4$)

Chrysoberyl has received much attention in China and abroad because it provides tunable lasing with phonon-terminated transitions. Because BeO is toxic, research on it has been confined to the Shanghai Institute of Optics and Fine Mechanics and the Anhui Institute of Optics and Mechanics. Starting in 1981, the former institute began growing chrysoberyl crystals, and lasing was reported the same year; tunable lasing was also recently achieved. The Anhui Institute of Optics and Mechanics manufactures chrysoberyl crystals with various crystallographic orientations.

C. $Ni:MgF_2$

$Ni:MgF_2$ single crystals measuring 24-30 x 30 mm were successively grown by the Shanghai Institute of Optics and Fine Mechanics, the Shanghai College of Communications, and the Beijing Workers' Glass Institute by a hermetic thermal gradient process employing graphite crucibles. Crystal stress and fracture were investigated for granular crystal samples with different crystallographic orientations, and the spectral properties, dislocations and growth stripes were analyzed. The Shanghai Institute of Optics and Fine Mechanics manufactured $Co:MgF_2$ crystals, while the Shanghai College of Communications developed Ni:MgO crystals which were used to manufacture low-temperature laser devices.

3. Color-Center Laser Crystals

By the 1980's, research on developing color-center laser crystals was underway at nearly 10 locations in China and both doped and undoped LiF, KCl, and NaF color-center crystals were being produced. Preliminary research was carried out on color centers (their formation, classification, stability and treatment in rotating molds). Tunable pulsed lasing from color-center crystals was achieved in 1981 by using a frequency-multiplying Nd:YAG laser to pump LiF crystals. Doped KCl will find applications in optochemical studies and in the measurement of standard frequencies. The Huaqiao University and other groups are collaborating in order to handle the many aspects of color-center research, which is closely allied to progress in materials science and instrumentation and may serve as a stimulus to further basic research in related areas.

4. Research on New Laser Materials

Research on new laser materials was begun in China in the 1970's in order to meet the requirements of the solid-state laser industry, which was undergoing diversification. The crystals Nd:$Ca_5(PO_4)_3F$, Nd: $CaY_4(SiO_4)_3O$, Nd:YVO_4, various rare-earth-doped $Gd_2(MoO_4)_3$, $Ca_5Y_{13}F_{49}$, and other new laser materials were developed in succession by the North China Research Institute of Electro-Optics. Research has just begun on multipurpose laser crystals which exhibit self-Q-switching, self-mode-locking, and other properties, and novel phonon-terminated laser crystals are being investigated in cooperation with the Beijing Workers' Glass Plant. The Fujian Material Structure Institute is studying how the crystal structures are related to the lasing properties and has suggested using a combination of crystal lattice dynamics and crystal field theory to search for new laser crystals with phonon-terminated transitions. The novel crystal Cr:$YAl_3(BO_3)_4$ was grown on the basis of investigations into the structural properties of crystals. Spectroscopic studies revealed an R line at λ = 684 μm and a very intense phonon sideband in the 690-750 μm wavelength range. The Shanghai Institute of Optics and Fine Mechanics has spectroscopically analyzed several oxide and fluoride materials doped with rare-earths or transition elements, and the Anhui Institute of Optics and Mechanics is investigating phonon-terminated laser crystals to see if new crystals can be grown from salt melts. The Changchun Institute of Applied Chemistry has grown a series of small, self-excited crystals which lase at new wavelengths (e.g., $KNdP_4O_{12}$, Mn:CeP_5O_{14}, $Tb_xDy_{1-x}P_5O_{14}$). The Shanghai Silicate Institute produced molten $K_5Bi_{0.9}Er_{0.1}(MoO_4)_4$ single crystals of identical compositions and carried out spectral and structural studies. Research on the growth and properties of Eu:GGG and Tb:GGG crystals was carried out at the Beijing Institute of Physics. Additional basic research on developing new materials is also in progress at several other colleges and universities.

5. Providing Conditions Suitable for Development of Laser Crystals

Before the 1960's, Chinese research on crystal growth and analysis was virtually nonexistent because most of the prerequisites were lacking. The dissemination of foreign research results on laser crystals was a powerful impetus toward ameliorating the situation in China. In order to grow oxide crystals which have high melting points and exhibit lasing, various institutions in China[1] formulated plans for building furnaces for growing single crystals with stable precisely reproducible properties by the Czochralski method using conveyor-belt systems. Semiautomatic programmable temperature-control equipment, automatic aerometric positioning systems, automatic electronic balances, and systems of gears for aligning the growing crystals were developed. Although most of the control systems are quite reliable, electronic balances do not operate stably. Experiments are now underway on automating control systems by using microprocessors.

The Kunming Precious Metals Institute established a technique for processing iridium in the late 1960's and has since then been supplying various types of iridium products needed in China's program for developing inductive-heating methods for growing high-melting iridium oxide crystals.

In the mid-1970's, the North China Research Institute of Electro-Optics began developing a mid-frequency controlled silicon power source for a countercurrent device which operates stably over long times and can be used to grow crystals by the Czochralski technique. This device has several advantages (there is less danger of human exposure, and the frequency can be selected to match the skin thickness of the iridium crucible so as to eliminate mid-frequency interference for low currents in the control circuit); as a result, the system is widely employed in China. Research has also been done on laser spectrometers and on quantitative analysis of the laser-active constituents of crystals.

The Shanghai Institute of Optics and Fine Mechanics succeeded in modifying the directed temperature gradient method for growing crystals and used the new process to grow opal single crystals. This institute has also cooperated with the Changchun Institute of Optics and Mechanics in growing large Nd:YAG crystals.

In terms of instrumentation, we may cite the Twyman interferometer manufactured by the Huadong Institute of Engineering, which is now widely used in China. Other measuring equipment includes diffractometers, absorption meters, devices for measuring laser properties, optical extinction coefficients, etc. Most of this equipment is not standardized but has been developed independently by various research groups. Although progress has been made, facilities for analyzing crystals in China remain quite primitive and in some areas are unavailable (e.g., there is no equipment for measuring laser quantum efficiencies).

6. Prospects and Suggestions

The pace of Chinese work on laser crystals has picked up markedly during the last 20-odd years, and considerable basic knowledge and facilities now exist. Although China is well behind the United States and the Soviet Union in research on laser crystals, it compares favorably with other countries in certain respects. We anticipate that within 10-15 years, China will become self-sufficient in the more common types of laser products and will begin to export them to other countries and supply new, useful laser materials with superior characteristics to the rest of the world. Specialized equipment based on laser crystals and integrated technology will perhaps make up the bulk of China's exports.

In looking back on China's progress, we must still realistically and objectively take stock of the weak areas that remain. In our opinion, the following five weaknesses should be addressed in order to prepare the way for new advances.

1) Research on crystal defects should be expanded. Crystal growth and crystal properties should be considered together, and serious attention must be given to achieving breakthroughs in the quality of laser crystal technology. In the next 5 years, methods must be found for growing high-quality crystals of large size (YAG, ruby, YLF, chrysoberyl, and mixed garnets such as Nd:Cr:GSGG, Cr:GSGG). Industrial production should be started at specific sites.

2) Basic research in the properties, structure and spectra of crystals should be strengthened, and new laser-active ions and matrix materials must be investigated. More research is needed on the performance of laser crystals and on transition mechanisms. The following five areas may prove critical in the development of new materials in the next 10 years: 1) tunable laser crystals with phonon-terminated or other types of transition schemes; 2) new wavelengths must be developed for rare-earth ions. Full use must be made of energy transfer mechanisms (sensitizing, deactivating, cascade, etc.), and efficient lasers with new wavelengths are needed; 3) color-center laser crystals. Existing crystals must be improved and new ones found, the physicochemical processes in color centers need to be studied further, and the problem of thermo-optical stability must be addressed so that color-center crystals will quickly become suitable for practical use; 4) multifunction laser crystals are needed; 5) develop new laser materials in the condensed state.

3. Insure that adequate facilities are available for growing crystals and developing related technologies. China needs specialized research and production centers for growing various types of crystals and building needed optical processing equipment and analytical and measurement instruments. Selective development of several types of advanced equipment, instruments, and integrated systems should be pushed in order to remedy China's backwardness in this area.

4. Improve the education of industrial and technical workers. We suggest that universities enroll more students specializing in crystallography and crystal research. Quotas should be raised on the number of students specializing in crystal materials who are sent abroad for study, and there should be more visiting scholars. Academic societies should be encouraged to give short course for the continuing education of on-the-job workers.

5. Government policies must be streamlined in order to resolve the problems of scattered resources, unnecessary reduplication, and confusion which afflict both production and research.

12617
CSO: 4008/46

BRIEFS

SICHUAN EARTHQUAKE FORECASTING CENTER--Chengdu, 3 Jan (XINHUA)--An earthquake research and forecasting center has gone into operation recently on the southern outskirts of Chengdu, capital of Sichuan Province. Nearly 200 seismologists at the center will carry out research work and make forecasts based on radio messages sent in from 20 telemetering systems and 50 seismological stations across the province. Sichuan is an earthquake-prone area. More than 60 earthquakes with a magnitude of above five on the Richter scale have been recorded over the past 14 years. Three of them with a magnitude of over six on the Richter scale were successfully forecasted. [Text] [Beijing XINHUA in English 1513 GMT 3 Jan 85 OW]

CSO: 4010/55

ARMED FORCES SPECIAL SYMPOSIUM ON MEDICINE OF ALTITUDES

Beijing JIEFANGJUN ZAZHI [MEDICAL JOURNAL OF CHINESE PEOPLE'S LIBERATION ARMY] in Chinese No 4, 20 Aug 84 pp 311-312

[Article by Kuang Yung [0066 0336]: "Summary of the Fourth Armed Forces Symposium on Medicine of Altitudes"]

[Text] The Fourth Armed Forces Symposium on Medicine of Altitudes was convened at the Third Military Medical College in Chongqing, 18-21 October, 1983. A summary of papers presented at the meeting is given below.

1. Acclimatization training. It is usually construed that acclimation training can elevate the adaptability of one's organs to altitudes, the papers given in the meeting have further supplied the theoretical basis for such belief. Twelve cyclists entered low-pressure modules which individually simulated 2,000m, 3,000m and 4,000m altitudes, and performed a maximum amount of secondary exercise three hours daily, for one to two weeks. Using ultrasonic cardiogram, pulmonary hemadromograph, three-lead (cardioelectric, cardiechema, and carotid pulse) physiological recorder, and measuring devices for red blood corpuscle, hemoglobin, and erythrocyte, the results show that: At 2,000m, the left ventricular function was strengthened, and acclimatization training can prevent the left ventricular functional decrease caused by simple oxygen deficiency. The heart structure can generate acclimatibility change, its storage capacity is strengthened, and the hemopoietic hemopoietic system does not occupy the primary position in this acclimatization process. The results of hemalactic acid and PWC_{170} (the work capacity at 170 pulses) indicate that even though the organ still relies on anaerobic metabolism to supply the energy after acclimatization training, but the capability of oxygenous metabolism has also been improved. In accordance with the distinct increase of urinary catecholamine discharge volume at 4,000m, the heart's capability has been strengthened and PWC_{170} has increased, this indicates that the strengthening of the sympathetic activity may cause certain effect in the aforementioned acclimatization process. The results of the electroencephalogram have indicated that acclimating first at the 2,800m altitude for three months, then entering into 4,700m altitude, the amplitude of its indicator has clearly dropped, showing that after staying at low elevation for a period of time, the organs have obtained certain acclimatibility. Experiments on animals have shown that after a domesticated

rabbit has undergone interruptive acclimatization training to anoxia, there is an alleviation in its inhibitory effect to its fever reaction induced by acute decompression anoxia caused Bacillus subtilis.

2. Drug prophylaxis. Since 1980, there have been more in-depth research into the elevation of an organ's endurance to anoxia. Refer to No 2, of the 1984 volume of this journal for detail.

3. Acute altitude diseases. At an altitude of 2,725-2,950m, there are four incidences of altitude pneumonedema, hitherto, the lowest altitude for incidence of this disease has been reported to be 2,757m in our country. In one autopsy of a pneumonedema victim, besides seeing widespread microthrombus, one can clearly see dilated blood capillaries and ecchymoma in the area of abundant pneumonedema fluid. There have been initial probes into the genesis mechanism and duplication of animals models. The normal large white rats and those with left lung removed will have pneumonedema primarily of interstitial type after being placed in the simulated altitudes of 5,000-8000m for 72 hours. The severity of dropsy is most pronounced in the rats with left lung removed, and in that group, it is most pronounced at the 48-hour mark; this agrees with the clinically observed pneumonedema disease incidence time. The difference in the severity of this kind of interstitial pneumonedema is not pronounced due to the removal of the left lung or the difference in the weight of right lung tissues. Experiments have further proved that the decrease in the osmotic pressure of the blood plasma colloid will not cause the aggrevation in the severity of altitude pneumonedema, and anoxia may not cause the heightening of the permeability of the micrangium mural.

As for evaluating the objective indicator of acute altitude reaction, an on-site observation was carried out at the Qinghai-Xizang plateau in 1979, with experiments conducted on human body using simulated decompressed anoxia. It was seen that the arterial blood oxygen pressure decreased and the urine volume decreased, and the myocardial oxygen consumption index, electro-cardiogram Q-T/T-Q ratio and the increase in the prin-ipal peak amplitude of the encephalon impedograph related to the degree of reaction to altitudes. Therefore, the evaluation methods of these physiological indicator combined with the semiology supplied can be tried in the evaluation of the severity of acute reaction to the altitudes.

4. Chronic altitude diseases. There is more research being undertaken for cardiopathy of the altitudes. From the experiments on animals to clinical observations, from X-ray examinations, electrocardiogram, to ultrasonic cardiogram, cardio-mechanical diagram, differential impedence cardiogram, vector cardiogram, and even the results of pathological examinations have all discovered that the heart patients of the altitudes have not only pulmonary hypertension, changes such as the right ventricular hypertrophy, etc, but also changes such as levocardiac functioning and structures. This shows further that heart disease of the altitudes can also affect the viewpoint on the levocardia, and have also supplied more objective indicators of the diagnosis on heart disease of the altitudes. In the experiments on piglets, it is found that the suitable indicators for determining the right ventricular hypertrophy are the absolute values of the ventricular mural thickness,

Hermann-Wilson index, and the lung weight/ventricle weight index. The experiments on the ectopic pulse stop of calcium ionic antagon agent, to further verify that the anoxic arterial pulmonary hypertension and heart disease of the altitudes are related, and it explains that ectopic pulse stop may be effective in the preventive treatment of anoxic arteria pulmonary hypertension and heart disease of the altitudes. Having conducted complete physical examinations and tracing observations of 154 inhabitants of high altitudes, the initial probes have yielded determining diagnosis standards of heart disease of the altitudes and pneumocardial disease. There are often pseudo left bias of the electric axis appearing in the altitude electrocardiogram, actually they are mostly extreme right bias, caused by the hypertrophy of the right ventricle, so this needs to be differentiated.

In the treatment of diseases of the altitudes, it has been seen that hypertension oxygen module treatment of acute altitude disease yields better result, but it has poorer treatment effect on chronic altitude disease, and it is considered that hypertension oxygen combined with the other corresponding comprehensive treatment will be an emergency rescue procedure for critical disease of the altitudes. The strobene treatment of altitude excess corpuscle disease it is more superior to use Red No 1 of the Chinese medicine. The trapping "jiagu"(?) treatment of the koilonychia of the altitudes gives better result. Polarized liquor has certain curative effect on myocardial anoxia of altitudes.

5. Others. Physio-biochemical survey data of healthy people have been obtained from the new and native residents of three areas of different altitudes (1,400m, 2,260m, and 3,720m), the greatest parametric values of the expiration flow speed and volume curve increases with that of the elevation. After a person has quickly entered the altitudes, his blood oxygen saturation fails as the elevation rises, then again it goes back up as his residency lengthens, getting close to that of a native, these are all beneficial to oxygen acquisition process of human body in the altitudes. At 3,200m, healthy adults have higher whole blood specific viscosity, whole blood reduction viscosity, and compressed erythrocyte volume, but the erythrocyte sedimentation rate is lower. The whole blood specific viscosity and compressed erythrocyte volume will increase as the rise in elevation of the location. There is no tendency in the increase of antialkali hemoglobin at 3,100m. The blood plasma high density lipoprotein cholesterol (HD-LC) of the emmigrants and natives of the altitudes are higher, also it increases with that of the total cholesterol (TC), maintaining the HDLC/TC at higher level and LDLC/HDLC at a lower level, this almost says that the incidence rate of coronary heart disease at the altitudes can not be lower than the plains. Due to the increase of erythrocyte, so increases may appear in serum bilirubin and hematuria acid in a healthy person, this has brought about certain complexity in the diagnosis of pathological jaundice and gout.

In the methodology of anoxic experimental research, a kind of oxygen distributed pressure microelectrode for measuring animal tissue has been developed, a measuring method has been established for observing the status of oxygen consumption of experimental animal's entire body, and this will certainly help in the experimental research work on anoxia of the altitudes.

12744
CSO: 4008/16

ARMED FORCES SPECIAL SYMPOSIUM ON MONOCLONAL ANTIBODIES

Beijing JIEFANGJUN ZAZHI [MEDICAL JOURNAL OF CHINESE PEOPLE'S LIBERATION ARMY] in Chinese No 4, 20 Aug 84 pp 310-311

[Article by Ma Wenyu [7456 2429 3558]: "Summary of Papers Presented at the Second Armed Forces Symposium on Monoclonal Antibodies"]

[Text] The Second Armed Forces Monoclonal Antibody Cooperative Research Symposium was convened at the Fourth Army Medical School, November 29 -December 4. Fifty-two people attended the meeting: they represented 21 organizations, consisting of cooperative members and invited guests. There were 19 papers read in the meeting. During the meeting, the Health Department of HQ, General Logistics Command had entrusted the Authentication Committee, with Vice President Goo Fanzhou of the Chinese Academy of Medical Sciences as its chairman, to organize an appraisal of the results of the stage of the Armed Forces' monoclonal antibody research. During this past year, our Army has made great stride in the development on monoclonal antibody research, it has generated or basically generated 58 strains of hybrid tumor clone for different specific monoclonal antibodies, and has established and improved on some detection methods. The papers are summarized in the following.

I. Pathogenic monoclonal antibody research of infectious diseases. There are dengue fever virus monoclonal antibody and immune fluoresence diagnostic preparation, and anthrax protective antigen monoclonal antibody developed by the Institute of Military Medical Sciences; the type B encephalitic virus and hemorrhage fever virus monoclonal antibody for renal syndrome by the Fourth Military Medical School; type B hepatitis nuclear antigen monolonal antibodies developed jointly by the 302nd Hospital and the General Hospital of the Urumqi Military Region, the antihuman Plasmodium falciparum monoclonal antibodies by the First Army Military Medical School, etc.

A. Dengue fever virus monoclonal antibody: Seventeen strains of types 1-4 specificity monoclonal hybrid tumor cells for antidengue fever virus have been generated by using the hybrid tumor technique of using lymphocyte on laboratory rats. The immune ascites antibody of these preparations have high titre and strong specificity. Fluorescence cross-typing appraisal of toxic strains has been carried out at 12 sites with the authenticated immune fluorescence preparation of typing of the dengue fever virus originally

developed in our country, comparatively satisfactory results have been obtained, and with greater value of application in actual work. At the same time, 14 strains of monoclonal antibodies have been generated for the cross-effect between various types, in order to go one step further to set up the condition for the analysis of antibodies for dengue fever virus.

B. Monoclonal antibodies for renal syndrome hemorrhage fever virus: The Vero-E_6 cells exposed to the renal syndrome hemorrhage fever virus 82-010H strain separated, by Shengxi personnel, are cultured in a liquor, with complete multipoint hyperdermic injection of BALB/C adjuvant solution on rats. Five weeks later, 0.3ml was inoculated in the abdominal cavity. Another week later, 0.1ml was injected intravenously, spleen were taken to fuse with SP2/0Ag myeloma cells of 14 rats on the third day, and 10 strains of hyprid tumor clone of secretive specificity monoclonal antibody were obtained. Selecting the two strains ($3H_4$, $4B_9$) monoclonal antibodies with high titres, the immune ascites titre is 80,000-320,000. After undergoing the initial immune fluorescence appraisals, all have shown positive reaction of toxic strain in our country, but the normal control tests show negative reaction. This was the earlier monoclonal antibody for the renal syndrome hemorrhage fever virus obtained in our country.

C. Monoclonal antibodies for type B encephalitic virus: the SA_4 strain immunity for type B encephalitic virus, after fusion, undergo ELISA, HI and IF detection procedures to screen out one strain aimed at the monoclonal antibody hybrid tumor clone of the B encephalitic virus SA strain, and the immune ascites ELISA titre is 10^{-5} - 10^{-7}, it is 1:640 for HI, and 10^{-4} for IF. After initial immunological appraisal, it is found that this antibody has higher HI activity, it has no complement fixation and neutralization activities, it has no cross-reactions with the encephalitis virus transmitted by ticks and Sindbis virus, but it has cross HI reaction with the St Louis encephalitis of the same subgroup; therefore, it possesses subgroup specificity, and it may be made into one kind of HI diagnostic reagent for jaundice virus subgroup. This antibody can be kept for six months at 4°C, it can withstand 56°C temperature for 30 minutes, ultraviolet radiation for four hours, and it is not affected by acetone processing, its antibody activity is not affected in pH6-10, and it has provided a convenient condition for the application of diagnostic reagent.

D. Type B hepatitis nuclear antigent monoclonal antibody: Use the nuclear antigen purified by the density gradient separation as the immunogen, after fusion, four strains of antinuclear secretion antigen monoclonal antibody hybrid tumor clone were generated. After four months of passing from generation to generation, stabilizing the high titre secretion antibody, the neutral tests and blocking tests have verified that antibody possess specificity aimed at nuclear antigen. It has certain application values for the antibodies for the clinical testing of the type B hepatitis nuclear antigen in a patient's blood.

5. Antrax protective antigen monoclonal antibody: Using the immune rats with bacillus affinity layer antigen to produce a strain of antianthrax protective antigen monoclonal antibody hybrid tumer clone, culturing it

externally can help to continue secretion antibodies, and the abdominal cavity of the rat can produce high value antibodies. Coupling the monoclonal antibodies with CNBr-Sepharose 4B, pass it through the anthrax affinity layer antigen. Its analytic solution is made to undergo the polyacrylamide gel electrophoresis, only one protein strip is seen, but there are four affinity layer antigen strips, this has some practical meaning in the preparation of high purity vaccines.

Furthermore, it has generated the anithuman Plasmodium falciparum monoclonal antibodies, and it has moved one step further in the study of its specificity and its value of clinical applications.

II. The research of tumor-related monoclonal antibodies: There are antigen monoclonal anitbody related antihuman nasopharyngeal carcinoma, antigen monoclonal antibody related to liver cancer cell, and monoclonal antibody related to antihuman prostatic acid phosphatase developed by the Fourth Army Medical School, and the antihuman panleukocyte monoclonal antibody by the Academy of Military Medical Sciences, etc.

A. Antihuman panleukocyte monoclonal antibody: Using the peripheral mononuclear blood cell of an immune rate to fuse with the NS bone marrow cell, processed by the enzyme dying method to select by sifting in generating a strain of monoclonal antibody hybrid tumor clone aimed at leukocyte concomitant antigen--IC34-5. This antibody can specifically affect leukocytes such as T-lymphocyte, B-lymphocyte, mononuclear cell, and ploykaryocyte, and, not affect erythrocyte and platelet. Although this antibody is not aimed at some specific tumors, it is helpful in the morphological observations to determine the sources and characteristics of tumor cells. The author has used the IC34-5 monoclonal antibody to study the lymphonodus containing metastatic carcinoma cells, the resultant cancer cell is not affected by this antibody, but the lymphomatous clones are affected. In the clinical differential diagnosos of lymphomatosis and metastatic carcinoma, and in the analysis of leukocyte antigen, these are certain potentials for applications.

B. Antihuman nasopharyngeal carcinoma related monoclonal antibody: Using low differentiation nasopharyngeal carcinoma dermois strain CNE-2 of an immune BALB/C x Swiss F_1 laboratory rat to fuse with bone marrow tumor cell of a rat, four strains of hybrid tumor clone for antigen related to nasopharyngeal carcinoma are obtained. They react with nasopharyngeal carcinoma clone and nasopharyngeal carcinoma tissue slides, but not with osteosarcoma cell, cancer cells of uterine cervix, esophagus carcinoma cells, fiber mother cells, etc. Currently, this research is going one step further to determine its specificity, and to remove its reaction to EB virus and pure herpes virus.

C. Antigen monoclonal antibody related to liver cancer cells: Using liver cancer generative clone MMC-7721 immune laboratory rat to produce a strain of monoclonal antibody hybrid tumor clone--FP-4 of anti-liver cancer-related secretion antigen. Indirect immune fluorescence testing shows that this antibody and the cancer cell SMMC-7721 and cancer tissue slide show positive

reaction to other tumor tissue and heart, liver, spleen, lung, kidney, brain, prostate gland, etc of normal people; this shows that it has a constant specificity. In further observing the specificity of FP-4 monoclonal antibody, it is hoped that this may apply to clinical diagnosis and liver cancer pathological research. In addition, the monoclonal antibodies of human liver cancer cell ferroprotein and membrane protein have basically been generated, to carry the research into the properties of liver cell ferroprotein and membrane will determine the value of application of monoclonal antibodies.

D. Antihuman prostatic acid phosphatase (PAP) monoclonal antibody: Use purified PAP immune rat to generate anti-PAP monoclonal antibody hybrid cancer clone, then use the indirect ELISA testing to verify that this monoclonal antibody is specific. Currently, the appearance of PAP in the blood serum can be considered as the indication of prostate cancer, therefore, the testing for the appearance of blood serum PAP has certain meaning in the early diagnosis of prostate cancer. Antihuman PAP monoclonal antibody is more sensitive than multiclonal antibody, it is more specific, and it ean elevate the sensitivity of current testing methods.

III. Others. The Liberation Army's General Hospital has used the patient's abdomino-thoraic water, prepared by affinity layer analysis which have generated a strain of monoclonal antibody hybrid cancer clone of antihuman C-reactive protein, on C-reactive protein immune rats. It has undergone ELISA determination to verify that it is specific, and it has shown positive reaction in the blood serum of a patient with elevated C-reactive protein. The C-reactive protein tests have certain reference values on the diagnosis of acute inflammation, tumor or tissue damage.

Furthermore, the Navy General Hospital and the Urumqi Military District General Hospital have jointly conducted initial experiments on the preparation of insulin monoclonal antibody, and have mastered the suitable immune dosage and immune methods. In four fusions, 3 percent positive clones have been achieved twice, and more research is continuing.

IV. The establishment and improvement of testing techniques. Rapid, sensitive, specific, and microtesting techniques are the required methods of sifting and determining the monoclonal antibody, the widely used testing methods are immune fluorescence, enzyme related immune absorption testing, enzyme dying radioactive immune analysis, etc. In order to prepare interferon monoclonal antibodies, the Second Military Medical School has established the initial direct neutral and neutral precipitation testing techniques. The Fourth Military Medical School has come forth with a usable method which uses the complete somatic antigen as the ELISA sifter for anthrax capsule monoclonal antibody. Additionally, there will be single layer cell microculture plate, using 0.025 percent glutaraldegyde fixation, and it can undergo indirect ELISA method to test for the cell surface antigen monoclonal antibody.

Monoclonal antibody technology is an important breakthrough technique in biological medicine. Monoclonal antibody possesses high purity, strong

specificity, the characteristics of easy to standardize the reagent, and it has potentially important applications in the diagnosis of infectious diseases, preventive treatment, and in understanding tumor, and, the immunopathy pathogenesis and immunological regulations. It will advance the immunology theory and application to a more precise stage. Therefore, it has increasingly attracted highly valued attention. Since the foreign establishment of this technique in 1975, several hundreds of hybrid cancer clones have generated. Among these, more than ten kinds of monoclonal antibodies have entered into manufacturing stage, they have been tried in clinical diagnosis and treatment, and the economy has been benefitted. Our armed forces had established an All Army Monoclonal Antibody Research Cooperative Group in October 1982. In the past year, more than ten units have successively established laboratories, with emphasis on the research into the application and development of monoclonal antibodies. Henceforth, in clinical diagnosis, and in prophylaxis and treatment, monoclonal antibody will eventually replace the usual blood serum detection method, and it will greatly elevate the diagnostic specificity, sensitivity, and duplicability.

CSO: 4008/16
12744

STATUS OF ENVIRONMENTAL LAW IN CHINA

Beijing ZHONGGUO HUANJING KEXUE [ENVIRONMENTAL SCIENCES IN CHINA] in Chinese No 3, Jun 84 pp 45-49

[Article by Song Jiping [1345 1142 1627] of Economics Department, Hubei Provincial Higher People's Court, and Shao Boding [6730 0130 1353] of Department of Law, Hubei Finance and Economics College: "Status and Fundamental Principles of Environmental Protection Law in China"]

[Text] Under China's socialist legal system, the status and fundamental principles of the Environmental Protection Law (hereafter referred to as the Environmental Law) are important theoretical problems constantly relating to China's environmental law in recent years. A correct understanding of these problems can meet the demands of teaching environmental law and satisfy requirements to enhance the socialist legal system as applied to environmental protection.

I

The status of environmental law in China's socialist legal system centers on the problem of whether or not environmental law can be an autonomous field of law. Views vary. Some definitely hold that environmental law is an autonomous field. This view is mostly seen in universities that teach environmental law. Although those who disagree with this view do not definitely state that environmental law is not an autonomous field, they indirectly speak of environmental law as not being autonomous but belonging to other legal sectors. Some say that the first mission of environmental protection is to intensify environmental management; management must be subordinate in relationship, thus environmental law is encompassed by administrative law. Others say that the basic purpose of environmental protection is to protect the health of the general population. Since the people engage in labor, it is held feasible to include environmental law under the system of labor law. In May 1980, the All-China Federation of Trade Unions, the State Labor Bureau, and the Ministry of Public Health cooperated in drafting a series of environmental laws and regulations, including the Environmental Protection Law of the People's Republic of China (Provisional), Health Standards in Designing Industrial Enterprises, and Radioactive Isotopes Occupational Hygiene Preventive and Protective Management Regulations. These laws and regulations further embody the people's concept about labor law including environmental law. Some others

consider that the ultimate victim from contamination and destruction of environment is man. In our daily life, we see a rising tide of lawsuits on eliminating hazards or compensation for damage incurred due to environmental pollution. Hence, it is also feasible to include the environmental law in civil law. Many people believe that under the stipulations of Article Three in China's Environmental Law, the environment includes the atmosphere, water, land, mineral deposits, forests, grasslands, wild animals, wild plants, aquatic life, scenic locations, relics, sight-seeing areas, hot springs, convalescence areas, conservation areas, and residential areas. Thus, environment includes the natural resources; this is the major component part of socialist economic construction. Hence, it is more appropriate to incorporate environmental law into economic law. In China's first post-liberation publication FAXUE CIDIAN [DICTIONARY OF LAW], in the clauses of economic law it is clearly pointed out that economic law generally includes management of industry and agriculture, protection of natural resources and the environment.... In JINGJI FAXUE [ECONOMIC LAW] published in May 1983, there is a chapter, Legal System of Environmental Protection, stating that many social and economic relationships modified by the economic law cannot be modified by civil law, such as economic relationships in planning, and economic relationships in the management of environmental protection. In the author's (of JINGJI KEXUE) opinion, environmental law is subsumed under economic law, not civil law.

We maintain that environmental law is a very important, autonomous branch of law in China's socialist legal system. This is a conclusion relying on numerous factors.

First, to regard environmental law as an autonomous legal branch is an imperative trend in China's societal developments and is dictated by social and economic conditions objectively existing in our country today. We know that any legal application is ramifying with social production in a class society, to be gradually refined. In Chinese society, whether the slave system or feudalism, the legal system was a mixture without divisions into criminal, civil or marriage law, without divisions into the emergence of modern mass production, especially after people witnessed environmental pollution caused by this modern production. For example, during the early post-liberation years, China's industrial foundations were very weak. At that time, although there was pollution of limited time and space, yet soon enough nature's capability for self-cleaning eliminated pollution. China's industrial production saw great changes after more than three decades. From the Sixth Five-Year Plan of Chinese national economy and societal development, in 1985 China's power generation will reach 362 billion kilowatt-hours, 33.5 times the 1954 level; the 1985 coal output will reach 700 million tons, 8.5 times the 1954 level; the 1985 steel production will be 39 million tons, 18 times the 1954 level; the 1985 cement production will be 98 million tons, nearly 21 times the 1954 output; and the 1985 paper output will be 6 million tons, 12.5 times the 1954 production. The general growth of industrial production proceeded from weak to strong and from nonexistent to existent; by now, an independent relatively complete industrial system has been built in China. By not paying attention to the prevention and control of pollution during the rapid growth of industrial production, the environment was seriously impaired. Therefore, effective protection and bolstering of the environment and incorporating environmental

protection into the socialist legal system are a major strategic decision and also meet the requirements of the society and national economy now developing. The conclusion is, the "Department of modernization requires environmental protection and its law." In Comrade Deng Xiaoping's words, "Emphasizing the regulating criminal law, civil law, code of civil (or criminal) procedure, ... environmental protection law"[1] and the convening of the Third Central Party Committee of the Eleventh Party Congress, it was stressed that socialist democracy and the socialist legal system should be enhanced; this creates a desirable political condition for environmental law becoming an autonomous branch of law.

Second, that environmental law is an autonomous legal branch is consistent with the motive of China's socialist production. In the words of Joseph Stalin, "Based on high technology, ever more numerous and perfecting methods lead to ensuring that are continually satisfied, to the maximum, in material and cultural demands of the entire society."[2] An important organic component part of our progressing socialist modernization program today is the environment (including the natural resources); this is the material base of socialist production. Once the environment is protected, the supply base of all raw materials required by socialist production is protected. This is of course consistent with the motive of socialist production. We must notice that the basic motive of environmental protection is not only the protection of natural resources, but also more importantly, protecting the population's health. Therefore, we can say that the existence of environmental law is the people's demand and aspirations. This law is the self-confident manifestation of the people's aspirations and built thereon.[3]

Third, once environmental law plays a role in socialist life, the law has its prescribed object of modification, the adjustment of social relationships stemming from protecting and enhancing the environment. This aspect differs from that of economic law. More than two centuries have passed since French utopian socialist Morelly advanced the concept of economic law in 1755 in his work CODE DE LA NATURE [CODE OF NATURE]. However, the exact meaning of the economic law itself has received different interpretations in the world. In various countries, economic law has quite different standing. Its main purpose is that the law does not have (or there is no certainty about) its object of modification. The case is different for environmental law; its modification object is clear and well-defined. From this vintage point, environmental law ranks higher in the legal system than its precursor, economic law.

Finally, the features of environmental law itself make it an autonomous legal branch, namely: (a) A polluted environment destroys the ecological balance, resulting in threats and damage to public health. Strict enforcement of environmental law is beneficial to human health. (b) The relationships between environmental law and natural science are very intimate. Rapid progress in modern science and technology makes for mutuality between the social and the natural sciences. Environmental law itself is within the scope of social sciences but with the interaction of the natural sciences. The natural sciences not only modify the clauses in laws and regulations of environmental protection, but also the fundamental law of environmental protection; some clauses betoken the organic merging of the social and the natural sciences.

(c) It is relatively apparent that environmental law manifests the social, public interests because the victims are many as soon as the environment is polluted and the ecological balance is destroyed. There are latent and persistent periods for some pollutants; some pollutants will cause damage to the second, or even the third generation of the polluted victim's descendants. Other pollution, such as pollution of the atmosphere, rivers, seas or oceans, may cross national boundaries. (d) Environmental law and economic growth are closely related because productive activity is the most fundamental practice and activity.[4] Through the productive, distributive, exchange and consumption activities of man, the economy keeps progressing. All these activities influence the environment and are influenced thereby. Therefore, many countries in the world consider environmental protection to be the foundation and primary content of economic growth. Although environmental law has a wide scope of modification objects, protected objects, and objects of prevention and treatment. To a nation, the scope includes all its land, sea and air territories. To the world, the scope reaches all the globe, even near space. As viewed from the social relationships modified by environmental law, the law relates to almost all social departments and all people. Up to now, no other branch law has such broad sweep. (f) Environmental law has relative stability and persistence. The substance of environmental law, especially materials relating to environmental norms, pollutants emission norms, monitoring method, and calculation formulas, are more stable and persistent than any other branch laws. As proven in life, generally environmental law is not affected by social or political movements, and does not change because of different leadership groups. For example, the Stipulations on Protecting and Enhancing the Environment, promulgated in August 1973 can be said the prototype of the Environmental Protection Law of the Chinese People's Republic (Provisional) promulgated in September 1979. Many materials in the stipulation are included in the later law. (g) When investigating the legal responsibility of involved persons in environmental law, it does not adhere to some traditional principles in criminal or civil law. For example, many countries in the world have such a general principle that the accusant in a criminal case is responsible for providing evidence. In many countries, however, the responsibility of providing evidence in environmental law is or will be the province of the defendant. For another example, on the principle of neglect of responsibility, when the legal responsibility of an individual is investigated, his actions should be found to violate some law. Subjectively, negligence (or intention) and a fact of injury should be present. There should be a cause-and-result relationship between intention (or negligence) and injury. This ancient principle inherited from Roman Law is adopted by almost all countries. In investigating the legal responsibility of involved persons under environmental law, however, some countries have begun to embrace the principle of no-fault responsibility, in discarding the pattern of Roman Law and opening a new line of approach. In China's environmental law, although no clarification is given for the two above-mentioned problems, China is a socialist country, which should embrace the basic interests of the masses. Hence, we can expect that the principle of transfer in evidence responsibility and enforcement of no-fault responsibility is an imperative trend. These features in environmental law are absent totally or in part in other branches of law. Hence environmental law cannot be subsumed in any other branch of law. The only conclusion is: environmental law is an autonomous legal department.

II

The fundamental principle of China's environmental law is the regulation of environmental law and carrying out the guiding spirit and behavioral criterion of environmental law. This manifests the socialist character of China's environmental law; this is an important aspect distinguishing it from the environmental law of capitalist countries. Therefore, the fundamental principle is an extremely important (and fundamental) theoretical problem in China's environmental law. However, there is a major divergence on this extremely important problem. Some comrades hold the following views about the fundamental principle of China's environmental law: "Environmental protection for the people's welfare," "Overall consideration," "Combination of prevention and control measures with emphasis on prevention," "Comprehensive planning, rational layout, and converting harm into benefit," and "Combination of award and penalty." Some other comrades want the following views to be included in the fundamental principle[5] of the environmental law: "Planning of active treatment measures should be made for long-standing pollution sources. For enterprises with a glaringly irrational layout, considerable waste of resources and energy, and strongly adverse reaction by the population because of lack on treatment measures against severe pollution, the authorities should order treatment measures, conversion, merging, transfer or restrictions, as well as necessary steps of closure, suspension or relocation." There are different views in many publications on the fundamental principle of environmental law.

We consider that the fundamental principle of China's environmental law should be the guidance and behavioral regularity criterion highly abstracting from the regulation and enforcement of environmental law by the revolutionary regime under the Party leadership. The environmental law not only concludes the experience of more than three decades since liberation, but also includes the record of environmental protection in the Party's revolutionary base during the new democracy revolution period. These records should be rooted in China's practical situation, revealing the practices and guidance of reality that is unique in environmental law. Of course, there are alternative and repetitive environmental phenomena. Based on this recognition, the fundamental principles of China's environmental law are congruent with the five following principles:

A. The principle of unifying environmental benefits and economic results: The supreme goal and basic guiding concept of China's environmental legislation is to promote socialist economic growth and to protect the people's health. As stipulated in Article Two of the Environmental Law, "The mission of the environmental protection law of the Chinese People's Republic is to ensure the rational utilization of the natural environment for prevention and recovery measures of environmental pollution and ecological destruction in the socialist modernization program, thus creating a clean and adequate environment for people's livelihood and labor, protecting the people's health, and promoting economic growth. In the 32-character policy statement on environmental protection work, the last eight characters are "protect the environment for the welfare of people." The statement indicates the insistence of environmental benefits and economic results from different aspects. Last year, the State Council again reiterated and upheld the principle of uniting economic results

and environmental benefits.[6] In the developmental history of some capitalist countries, environmental benefits were neglected because of the blinded pursuit of rapid economic growth and price of products, thus leading to severe economic loss and endless misery to the people. Our party and state are paying more and more attention to environmental protection, and are making significant achievements. Particularly now, our party has more extensive recognition of and more experience with the rules of China's socialist construction. We have more mounting self-confidence and firmness in thoroughly carrying out our correct policy;[7] we are able to organically merge the two. When making major decisions on environmental problems, current needs should be met and long-term interests should also be considered. This requires us to incorporate environmental protection work in the development plan of the national economy under rational arrangements and unified planning, thereby taking individual parts into consideration. The union of environmental benefits and economic results must be ensured. However, reality and life in society are very complex, and public acceptance is not entirely consistent. In China, sometimes environmental benefits and economic results are not unified, but even at cross-purposes at times. This demands that we firmly maintain the supreme goal of environmental protection for the people's welfare as stipulated in China's Environmental Law.

B. The principle of combining prevention and control with emphasis on prevention: Environmental management is stressed in countries today, whether socialist or capitalist. However, the goals and measures of management are different. In Lenin's words, "What a capitalist is concerned about is how to manage by plundering wealth, and how to plunder via management."[8] Therefore, from its nature a capitalist country cannot fundamentally control pollution and protect the environment; it even is less likely to have preventive measures put into effect before any pollution occurs. The unavoidable route is pollution first and recovery measures later; this route will be followed, now and then. This is decided by the societal system of capitalist countries with private ownership of production means as their foundation. What about China? Undoubtedly, within a certain period and to a certain extent, the zigzag route of pollution first and recovery measures later is also followed. However, we are a socialist country with its foundation built on the public ownership system of production means; we practice a socialist planned economy. The nature of our State dictates that we cannot continue to follow the zigzag route. In addition, China's economy is relatively backward compared to some countries. We do not have such an abundance of funds for pollution control. Hence, we should adopt the principle combining prevention and control with emphasis on prevention. China's Environmental Law and many other laws stipulate the regulations of the three simultaneous efforts, assessment of, and environmental impact statements. These elements embody the spirit of emphasis on prevention. In particular, the regulation of the three simultaneous efforts is a fundamental measure to maintain the ecological balance, prevention of new pollution and destruction of the environment; this is a long-term strategic decision. This is China's innovation of an important legal system for environmental protection. Some people consider that it is nonsense to talk about emphasis on prevention in a severely polluted area. This is a misunderstanding because the principle of combining prevention and recovery measures with emphasis on prevention does not mean the weakening of treatment.

However, when prevention is concretely carried out, new environmental pollution and destruction will not occur; thus, long-standing long-term pollution can be treated with concerted efforts.

C. The principle of comprehensive utilization: The dialectical method of Marxism tells us that there are no wastes. Although human excreta lacks any direct use by man, it is a superb manure in farming. At the Shanghai Biochemical Pharmaceutical Plant, a valuable first-aid drug, urease, is purified from human urine; the price of the drug is 1000 times the price for the same weight of gold. Today's refuse may become precious wealth tomorrow when material appreciation and technical level are enhanced. Wastes in one place may become production raw material somewhere else. Therefore Marx said, "So-called wastes may have important functions in any trade."[9] A common saying goes: "Everything should begin from reality." Presently, China is weak in economic strength but has a billion-strong population. The utmost reality in China is food first and construction second. Hence, comprehensive utilization bears positive significance for all factories, agencies, collectives, troops, schools and citizens. Comprehensive utilization not only can create wealth for the State and society, but also can relieve pollution of the environment. This is a public good (one stone, two birds). Comprehensive utilization is an effective, positive measure in environmental protection work. This is also an important principle that should be adhered to in China's environmental law.

D. The principle of combining administrative supervision and public supervision: As stipulated in Article Eight of China's Environmental Law, "A citizen has the right to monitor, prosecute and accuse a unit and an individual committing pollution and destruction of the environment." This is a vivid manifestation of the Party's mass line in environmental protection work. Environmental protection relates to all households, all units and everybody. Mass monitoring is not only a great movement, but also the manifestation of masses as their own masters. However, it is insufficient to only have mass monitoring; coordination from special agencies is also required. As stipulated by Articles 26 and 27 of the environmental law, the supervisory authorities of environmental protection agencies at the central and local levels are specified. The combination of two types of monitoring can produce a tremendous force with decisive significance.

E. The principle of combining awards with penalties: An award system is stipulated in Article 31 of China's Environmental Law, and a penalty system in Article 32. There are awards and penalties with well-defined regulations; this has a profound effect on inducing positive actions in a unit and by an individual toward environmental protection. As proved by years of practice, good effects came from adhering to the principle of awards and penalties. This not only encourages any unit and anyone performing good environmental protection work, fines the violater of environmental law, and maintains normal order in environmental protection work.

Although there are manifestations of the above-mentioned principles (D) and (E) in other branches of laws, yet there is different substance. By adhering to the fundamental principle of China's environmental law, better effects can be obtained; as the outcome, the regulation and enforcement of China's environmental law can be ensured.

BIBLIOGRAPHY

1. DENG XIAOPING WENXUAN [SELECTED WORKS OF DENG XIAOPING], page 136.

2. Joseph Stalin, SOCIALIST ECONOMIC PROBLEMS IN THE SOVIET UNION, 1958 edition, (People's Press), page 30.

3. COMPLETE WORKS OF MARX AND ENGELS, Vol I, page 184.

4. SHIJIAN LUN [ON PRACTICE] and MAO ZEDONG XUANJI [SELECTED WORKS OF MAO ZEDONG] (one volume edition), November 1967 pocket-size edition (horizontal lines), page 259.

5. Fan Ming [0416 2494] and Liu Bojun [0491 0130 0689], "Basis and Supporting Views of Environmental Management," HUANJING GUANLI [ENVIRONMENTAL MANAGEMENT], 1983, No 2.

6. State Council, "Stipulations on Prevention and Control Measures of Industrial Pollution With Technical Reform," 6 February 1983.

7. DENG XIAOPING WENXUAN, page 371.

8. "How to Organize Competitions," SELECTED WORKS OF V. I. LENIN, Vol III, page 395.

9. COMPLETE WORKS OF MARX AND ENGELS, Vol 25, page 117.

10424
CSO: 4008/369

AIR POLLUTION CONTROL IN CHINA DISCUSSED

Beijing ZHONGGUO HUANJING KEXUE [ENVIRONMENTAL SCIENCES IN CHINA] in Chinese No 3, Jun 84 pp 7-10

[Article by Zhao Dianwu [6392 3013 0063] of Institute of Environmental Chemistry, Chinese Academy of Sciences: "Problems of Atmospheric Pollution and Its Control in China"]

[Text] I. Background on Air Pollution

In the summer of 1979, an Information and Science Exchange Conference on Atmospheric Pollution: Its Prevention and Control was convened at Shenyang. At the conference it was stated that the major pollutants emitted in coal combustion are ash and sulfur dioxide, severely polluting the air over large areas and inflicting great harm in Chinese cities. Thus, ash pollution in the atmosphere has been rated as a foremost concern.

Dust pollution occurs country-wide all year long. Pollution by sulfur dioxide mainly occurs during the cold seasons of the year in northern cities where high sulfur coal is burned. The acid rain pollution discovered in the past 2 years mainly involves areas south of the Chang Jiang, especially Southwest China where high sulfur coal is burned. Air pollution is more severe in inner city areas; generally, this pollution is quite moderate in the suburbs, falling below national norms. This is a brief description of air pollution in China. Besides dust and sulfur dioxide, there are some local air pollution problems mainly caused by fluorine.

When studying ways to combat air pollution and to broaden the scope of concern from the health of city residents to ecological protection of wide areas, we discover that there are gaps and weak sectors in our understanding of air pollution in China. We generally know the concentrations of pollutants in air basins over cities but we are not clearly aware of the situation in vast rural areas, the pollution sources or contributions made from different sources, and the probability of incidents of high pollution. In particular, we are ignorant of the extent of damage and loss caused by different air pollutants and at different pollution levels. Therefore, further study on China's air pollution is needed.

II. Major Pollution Problems

A. Dust pollution: Pollution from dust in the atmosphere includes pollution from dust and particles (particulate matter also includes suspended particles); here we deal only with particulate pollution, which are complex in chemical composition and with particulate size distribution from several sources. Only knowing particulate concentration levels in the atmosphere is inadequate. From studies in the Beijing-Tianjin area, approximately 19 percent[1] of the total atmospheric particulates have diameters less than 2 micrometers; in chemical composition, about 8 percent are benzene-soluble organic matter,[2] and the level of benzo (a) pyrene is upwards of 4 micrograms per 100 cubic meters.[3] However, the content of some toxic metals such as lead, chromium and cadmium are low, much lower than our environmental standards or foreign cities.[1] These facts show that the main toxic component of atmospheric particulates in the Beijing-Tianjin area is organic matter released in incomplete combustion of coal. The percentages of particulates from artificial sources (mainly from coal combustion) and from natural sources (mainly suspended dust) are approximately 6:4 during the cold seasons of the year and about 4:6 in other seasons.[1] Knowing this, the priorities in planning pollution control are obvious.

Regretfully, these data are available for only a handful of major cities. If the situation in the Beijing-Tianjin area is taken to generally represent North China, the situation in southern cities with different natural conditions should receive more attention. In South China, the climate is humid; vegetative cover is more widespread. The quantity of wind-blown dust of course is much lower than that in North China. After subtracting the contribution from wind-blown dust, the levels of artificial sources of atmospheric particulates in the south may not be much lower than in the north. Based on preliminary measurements, atmospheric particulates are alkaline in northern cities, but slightly acidic in the south. Generally, acidic particulates are held to be more harmful. Thus, one may ask though at lower levels, is dust pollution in the south a less severe problem than in the north? Answering this question requires a realistic study.

B. Pollution from sulfur dioxide: Sulfur dioxide is the air pollutant generally monitored in China. From available data, relatively severe pollution all year long occurs in major cities (such as Chongqing and Guiyang) from burning high-sulfur coal and lower capacity for atmospheric diffusion. In some major northern cities, the sulfur dioxide concentration is quite low in the seasons when residences are heated. Only in months of residential-heating season does the concentration rise rapidly, nearing or exceeding the class III standard of 0.25 milligram per cubic meter. In many other areas, the sulfur dioxide concentration is low in the atmosphere and is not yet a problem. Presently, specialists in foreign countries tend to consider that damage to health from sulfur dioxide is negligible.[4] In the alkaline environment of the north, acid rain and acidic sulfates are not likely. Another point needs to be mentioned: during the heating season in the north, indoor levels of sulfur dioxide are much lower than outdoors[5] because doors and windows are tightly closed and most of the time inhabitants live indoors. As revealed from monitoring data, the sulfur dioxide concentration in suburbs is much lower than

that in urban areas. From the foregoing, we see that at present pollution from sulfur dioxide does not yet pose an important problem in the north.

Except for a few major cities in Southwest China, sulfur dioxide levels in the atmosphere are low. However, the occurrence of acid rain complicates this problem. Assessing sulfur-dioxide pollution in the south can be done only after considering the origins of and damage caused by acid rain.

C. Pollution by acid rain: From the results of a nationwide investigation of acid rain in 1982, almost all cities with acid rain accounting for over one-half of total rainfall are situated south of the Chang Jiang; Chongqing and Guiyang in the southwest have the most severe acid rain. The incidence of acid rain is upwards of 90 percent; the average pH value is below 4.5^{6}. In southern cities with acid rain pollution, some have relatively severe pollution from sulfur dioxide, while other cities in this category do not. Although sulfur dioxide pollution is relatively severe in some northern cities, in others it is not severe. The reason is that the north has a generally alkaline environment and the atmospheric particulates are alkaline; thus, vast amounts of ammonia evaporate from the alkaline soil and enter the atmosphere so the atmosphere has high buffer capability against acid rain. The environment in most southern areas is acidic, so the buffer capability of the atmosphere is very low. The present problem is: what relationship exists between sulfur dioxide levels in the atmosphere and acidity of precipitation? Or, what concentration of sulfur dioxide will not result in acid rain? This is a complex problem since it involves numerous factors. At this time, we cannot answer this question.

In addition to acidity rates as bearing on acid rain pollution, we must come to understand whether this pollution is deleterious to the ecosystem. This demands a study on how sensitive the environment is to acid rain. As revealed in a preliminary study, the environment is insensitive in most northern areas, but in the south with a high incidence of acid rains, environmental sensitivity is relatively high. This is an unfortunate combination. There are many reports abroad about the ecological harm of acid rain. We also should intensify research in this area.

Abroad, acid rain is often related to long-range transport of acidic pollutants. According to monitoring data in China, most acid rain may originate from local sources. However, what is the contribution of long-range transport (especially in areas with low pollution of sulfur dioxide in the atmosphere but with relatively high acidity in precipitation)? This is an important problem which we should solve as it relates to counteracting acid rain.

D. Atmospheric pollution as a problem in South China: South China ranks high in our national economy so atmospheric pollution as a problem is again reviewed here. The northern cities consume large quantities of coal with dry climate and severe wind-blown sandstorms; thus, the levels of atmosphere particulates are quite high. In winter, sulfur dioxide also causes pollution to some extent. The data suggest that air pollution in northern cities is more severe than in the south. However, there are differences in air pollution in the south. Acid rain tends to occur in the south, so its effect may be adverse.

The former is a reality and the latter may be substantiated in the future. Levels of atmospheric particulates are low but the particulates are acidic. Coal contains higher sulfur percentages in the south. With increasing coal consumption, discharges of sulfur dioxide will rise rapidly so it is difficult to control sulfur pollution. Therefore, we should pay attention to the worsening air pollution in the south.

III. Sources of Air Pollution in China

Coal is the major energy source in China. Most coal is given no treatment before its consumption: untreated coal with high ash and sulfur content is burned. More than one-half of the coal is consumed in cities, accounting for very small proportion of the national land surface. The major combustion facilities are medium- or small-sized of low efficiency and with low chimneys. Without cleaning, large amounts of flue gases are discharged at low altitudes over densely populated areas. Presently, about 18 million tons of sulfur dioxide are annually discharged over China, less than 2 tons per square kilometer. This value is lower than in the United States (2.93 tons in 1977), the United Kingdom (21 tons in 1977), West Germany (14 tons in 1982) and Japan (7.8 tons in 1976). However, the discharge is concentrated in very small areas, causing severe local pollution in inner city areas.

Meteorological conditions are central in the formation of air pollution. In some areas with high air pollution, such as Southwest China and during the residential-heating season in the north, high-quantity discharges of pollutants constitute a factor, yet more important is the undesirable meteorological conditions hindering diffusion and dilution of pollutants. In the northeastern cities with an even longer residential-heating season, air pollution is significantly lower because the winds have high diluting capability for pollutants. Year-by-year changes in air pollution levels are similarly closely related to the meteorological conditions over the years. It is inappropriate to say that pollution levels are caused by artificial factors, such as increases or decreases in energy consumption. Rather, it is necessary to merge air pollution and pollution meteorology in research studies.

Landscape geography also plays a role in air pollution. The terrain in some cities hinders diffusion of pollutants; wind-blown sand in dry areas intensifies pollution by atmospheric particulates and acid rain tends to occur in areas with acidic soils, among other factors.

IV. Control of Air Pollution

Since air pollution is caused by excessive pollutants in the atmosphere, we should first of all reduce the amount of pollutants discharged. There are different air capacities in different areas; thus, there should be different reduction goals. Similarly air pollution can be prevented from forming optimal siting of pollution sources; in other words, the sources can be appropriately dispersed, not overly concentrated. Reduction and relocation are two avenues of action that can be simultaneously considered when prescribing plans of air pollution control.

The energy structure in which coal is used as the major source will persist in China for a long time. Air pollution caused by coal combustion should be controlled by adopting measures at three stages in time: before, during and after combustion. First, raw coal should be dressed and treated to reduce its ash and sulfur contents. Next, sulfur and ash should be solidified during combustion to reduce the initial concentrations of ash and sulfur in flue gas. Finally, the flue gas should undergo ash removal and desulfurization to lower the discharge of pollutants into the atmosphere.

There are large quantities of medium- and small-sized boilers as well as private coal stoves in China, contributing heavily to air pollution. In this situation, a realistic and practical measure is the adoption of clean solid fuel, block coal blended with a sulfur trapping agent. From surveys, discharges of ash, sulfur and alpha-quinoline from burning this clean fuel can be lowered by more than one-half (compared to burning loose coal) with higher combustion efficiency. After the incident of a smog outbreak in London, England, the use of smokeless solid fuel has relieved severe air pollution in that city. Similarly in St. Louis, Illinois, significant results have also been achieved within a short period. It is expected that the combination of clean solid fuel, low-pollution stoves, and ash removal in flue gas can control air pollution in China. The difficulties are not major, either as to engineering or as to economics.

The environment has a certain capacity to contain pollution; no harmful aftereffects will exist if the capacity is not exceeded. As to the pollution source of large, concentrated discharges in small areas, we must rely on optimal siting (or diffusion by high chimneys) to scatter pollutants so as to be innocuous, not exceeding the allowable concentrations for a given environmental capacity. This should be considered and studied as a routine measure.

High chimneys have a poor reputation abroad; this may be due to their overly high discharge rates, exceeding their design limits. Often pollutants in the flue gas should be diluted by some 10,000 times in order to meet the concentration norms at the ground surface. Even if there is 90 percent cleaning of flue gas and pollutant removal, a thousand fold further dilution is required; this depends on chimney height. As for the problem of whether or not pollution will exist in remote areas, this depends on pollutant discharge quantities and environmental capacity. By only not exceeding the allowable limits, we cannot say that pollution is being exported; at least, this is better than causing local, severe pollution. In addition, the particulates, which cannot be removed by ash trapping, can be diluted to harmless concentrations. Based on calculations, due to high chimneys the pollution effect of major urban pollutant sources amounts to only several tenfold more than surface sources. In different areas of China, there are different atmosphere diffusion capabilities and environment capacities. We should impose different stringencies on different pollution control measures by adapting to local conditions.

Although man cannot change the meteorological conditions affecting air pollution, we can conduct statistical calculations on pollution inducing

meteorological conditions by selecting a suitable probability of incidence as the basis for prevention and control planning, and not direct our efforts to cope with rare conditions. Pollution weather forecasts can be refined in major cities to avoid large losses by public precautions for severe pollution incidents.

V. Preliminary Conclusion

Long, persistent efforts are required to control air pollution. In order to find a way that is appropriate in China, it is necessary to further study the kinds and trends of air pollution in different areas, as well as the environmental capacity and damage due to air pollution. While we can be optimistic on the control of ash pollution, the control of sulfur pollution still poses a major difficulty. Especially in areas of high pollution, low diffusion capability, and consumption of high-sulfur coal, special studies should be required to prescribe appropriate measures.

Basically, controlling air pollution caused by coal combustion requires changes in energy structure. At present, we can adopt time-proven measures, simple technologies and low investments. With advances in technology and the economy in China, control measures can be gradually improved. The measures should aim at recovery and utilization of resources, especially sulfur. Technical measures should be combined with planning and management measures concerning present requirements and norms in different areas and during different time spans. These have been reported elsewhere, so we need not repeat them.

This article only enumerates some preliminary views on the problems confronted in this field. These problems need more study before they can be solved, so it is unavoidable that this report contains some unbalanced or even erroneous sections.

BIBLIOGRAPHY

1. Wang Anpu [3076 1344 3877] et al, HUANJING KEXUE XUEBAO [JOURNAL OF ENVIRONMENTAL SCIENCES], 1 (3), 220 (1981).

2. Chen Zongliang [7115 1350 5328] et al, HUANJING KEXUE XUEBAO, 1 (4), 267 (1982).

3. He Xingzhou [0149 5281 5297], ZHONGGUO HUANJING KEXUE [ENVIRONMENTAL SCIENCES IN CHINA], 1 (1), 59 (1981).

4. McCarroll, J., JAPCA, 30 (6), 652 (1980).

5. Jiang Hengguang [5592 0077 0342] et al, HUANJING BAOHU [ENVIRONMENTAL PROTECTION], (12), 14 (1982).

6. Ji Bin [4764 2430] and Cheng Zhenhua [4453 2182 5478], HUANJING BAOHU, (12), (1982).

7. Xu Dahai [1776 1129 3189] et al, ZHONGGUO HUANJING KEXUE, 2 (1), 1 (1982).

10424
CSO: 4008/369

$540-MILLION PROJECT TO ELIMINATE POLLUTION IN RIVERS

HK040547 Beijing CHINA DAILY in English 4 Jan 85 p 3

[Article by staff reporter Su Zhen]

[Text] Shanghai--A 1.5 billion yuan ($540 million) project is planned to eliminate pollution in the Huangpu River and its tributary, the Suzhou River.

Developed by the Shanghai Liquid Waste Management Study (LWMS), the project is aimed at diverting waste from the two rivers into purification sewers for treatment and eventual discharge into the Chang Jiang Estuary.

The pollution problem of the two rivers has been critical for many years. Statistics estimate the average daily flow of waste water to be about 3.4 million tons, of which 2.5 million tons are directly discharged into the two rivers. The Suzhou River, in particular, looks dark and stinks almost all year round.

The waste management programme, undertaken by the Shanghai government in 1983, has received financial support from the World Bank and the Australian government.

Zhao Zhongxing, 65, senior engineer and executive team leader of the project, told CHINA DAILY that the waste management plan, chosen from many options, is the first phase in the anti-pollution strategy. Minor revisions will be made before a final report is ussued early this year, he said.

The planned project's interceptor system will require about 70 kilometres of pipe, ranging in diameter from 1.4 to four metres.

The pipes will be laid through tunnels 15 metres underground and will stretch 650 metres offshore. Liquid waste will be discharged through 200 jets dotting the diffuser.

The discharged water will be mixed and diluted by the rapid flow of the Chang Jiang Estuary. Officials will monitor the water quality levels at the discharge point.

"We will take measures to see that the pollution index at that region will not exceed the State surface water quality standards," Zhao said.

According to Zhao, actual construction of the project, is scheduled to begin in 1986. The first phase, from 1986 to 1992, will intercept waste water flowing into the Suzhou River. The second phase will expand the project to the Huangpu River from 1991 to 1996.

The World Bank has agreed to offer aid of $100 million on the construction, Zhao said.

The Australian government has offered technical assistance through its Australian development Assistance Bureau. In 1983, the government commissioned a consortium of Australian consultants headed by Maunsell & Partners Pty Ltd and Pak-poy & Kneebone Pty Ltd in association with Binne & Partners Pty Ltd.

The Australian group, headed by Dr A.L. Downing, a British water expert, came to work with the Chinese on the research project. The Australian government offered aid of 1.7 million Australian dollars (1.5 million) in 198 [?] increasing the amount to 3.08 million Australian dollars ($2.8 million) in 1983.

CSO: 4010/54

SHANGHAI REDUCING AIR, WATER, NOISE POLLUTION

OW291301 Beijing XINHUA in English 1233 GMT 29 Dec 84

[Text] Shanghai, 29 Dec (XINHUA)--Thick black smoke has been banished from the skies above half of Shanghai's 12 urban districts under new anti-pollution measures, the municipal environment protection bureau said today.

Bureau director Chen Jiangtao said that by the end of October, Huangpu, Xuhui, Luwan, Putuo, Changning and Nanshi districts had converted 5,699 furnaces, kilns and stoves--about 96 percent of the total--to prevent them from belching out black smoke.

Mayor Wang Daohan had listed this as a priority environmental project for 1984.

To reduce noise pollution, the city has improved policing on five major urban roads where sounding of vehicle horns has been banned.

As a result, noise on the five roads has been reduced by an average of five decibels.

Preparations are now underway to build a mammoth project to direct water from the upper reaches of the Huangpu river, where water is relatively free from industrial pollution. Until now the middle and lower reaches of the river have been the city's main source of water.

The city would also decide on a program for sewage treatment, based on a joint report by Chinese and Australian experts.

CSO: 4010/54

AUTO EMISSIONS, CONTROL MEASURES ANALYZED

Changchun QICHE JISHU [AUTOMOBILE TECHNOLOGY] in Chinese No 9, 25 Sep 84 pp 58-61

[Article by Ni Shiru [0242 1709 1172]: "On Measures To Control Auto Emissions in Our Country"]

[Text] I. Current Situation of Auto-Emissions Pollution in China

1. Monitoring of Environmental Protection

In the work to monitor environmental protection in China, the monitoring of auto emissions has only just begun. For example, in large cities with more than 10 million people each, atmospheric monitoring standards are limited to only suspended particles, dust and SO_2 and there are no regular standards for such harmful components as CO, HC and NO_2 in auto emissions. There is of course no scientific analysis of the emissions and the rate of discharge of various cars operating under different conditions as well as the proportion of emissions in the density of air pollution.

Judging from incomplete results of air monitoring and using Shanghai as an example, dust, SO_2 and NO_2 all exceed the limits and exhibit the trend of annual increase. When compared with five large cities in Japan, the average value of NO_2 is higher as shown in figure 1.

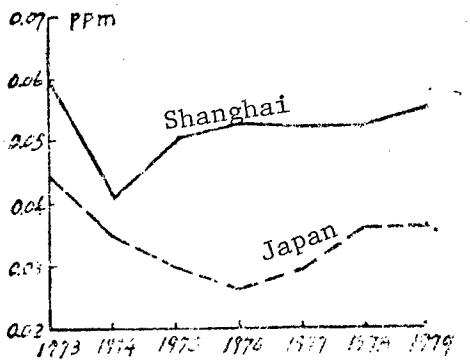


Figure 1. A comparison of the average value of NO_2 contained in the atmosphere of Shanghai and five major Japanese cities.

2. The Situation of Auto Operations

There are about 2.2 million cars in China and the number is still very small when compared with the developed countries. In the villages and countryside, auto-emissions pollution has not yet reached the level which may cause active or chronic poisoning and seriously affect or threaten the normal growth of animal and plants as determined by China's third level of atmospheric environmental quality. But in large cities, it has already become a threat to human health. For example, workers who have worked in a tunnel for more than 1 but less than 10 years all suffer from various degrees of the occupational illness of dizziness, palpitation, bronchitis, weakening of heart functions, unrestful sleep, loss of appetite and nausea. Tests have shown that based on a speed of 20 km/h, the average emissions per car is 120 m^3/h and if there are 7,000 cars traveling through the tunnel every day, the amount of auto emissions is 9,285 m^3, with as high as 12t of CO. If we use forced ventilation to dilute it, it would require large numbers of fans and electric motors whose capital construction funds and normal expenditures for electricity would amount to 40 percent of capital construction investment and maintenance costs respectively.

At present, there are 83,000 cars in Shanghai, 7.4 times more than the early days of the founding of the country. According to an analysis of the correlational factors in the forecast for the increase in the number of cars, there will be 300,000 cars by the end of this century. At that time, it will even be more difficult to control auto-emissions pollution.

3. The Situation of the Auto Manufacturing Industry

Based on incomplete surveys, only a half of the six large jointly-managed auto companies in China have begun research on auto emissions although most of them are inadequate and lacking in equipment and funds. In Shanghai for example, there are only three technicians engaged in such work. In the first and second quarters of 1983, only 1/25 of the time was given to such research in the engine-testing platform. Research funds and test car purchases have to be approved by every level, passing through many hands. Even for the entire industry, there are no more than 20-30 people engaged in research on the purification of auto emissions. Such conditions are ill-suited to the development and rejuvenation of our auto industry.

4. The Situation in International Auto Trade

It was not until September 1981 that the draft of China's auto emissions standards was prepared--15 to 20 years behind the developed countries. Our cars cannot enter international markets because their key emissions control technology fail to pass customs inspection. On the other hand, foreign cars can enter our markets without emissions control devices because we do not have auto emissions standards. In recent years, no one has inquired about the key technical measures of imported cars and very few key spare parts were imported. When negotiating with foreign countries on the issue of joint management, no one has looked into such technology.

It can be seen that auto emissions control in our country is still at the infant stage. Based on our many surveys, 50 percent of the cars exceed emissions limits and it has become a new mobile source of pollution.

II. Measures To Control Auto Emissions

The work to control auto emissions is difficult and strongly policy-oriented, involving such aspects as product quality standards, auto safety, energy conservation, management standards and environmental protection legislations. Therefore, it is closely related to the realization of the modernization of the auto industry and highway transportation. This work should be stressed and not delayed and should adopt the policy of comprehensive treatment and active prevention.

1. Comprehensive Treatment and Active Prevention

Practices in past years have proved that the solving of the problem of auto emissions is a significant systematic project. In other words, to be effective, the control of auto emissions has to be carried out simultaneously with related projects as shown in the figure.

The center of figure 2 is auto emissions control. To realize this objective, we must formulate various standards and regulations. As far as regulations are concerned, the most basic will be the standards limiting harmful auto emissions which in turn require the setting of the standards for quality, maintenance and periodic auto inspection to be enforced by units or agencies concerned. (Editor's note: beginning from 1 April 1984 various standards promulgated by the Environmental Protection Agency in September 1983: "Auto Emissions Under Idling-Acceleration Conditions" had been officially implemented). At the same time, appropriate scientific research on internal and external purification should begin and its results would enable the successful setting of national standards. The beginning of scientific research and the setting of standards will help to improve the development of testing equipments and technology which in turn guarantee the material means for scientific research and testing. To study the car's technical conditions, the degree of air pollution caused by auto emissions and urban air quality, we have to establish appropriate test centers. Thus, a systematic project of comprehensive treatment is formed. During the period from the Sixth 5-Year Plan to the Seventh 5-Year Plan to the decade beyond, such work should only be strengthened and not weakened. In large cities such as Beijing and Shanghai, the implementation of the whole system of comprehensive treatment is absolutely necessary.

2. Research on External Purification

When the technical conditions of the cars are different, external purification and the retreatment of emissions has practical significance. Even if internal purification is carried out, it would still be impossible to completely purify the harmful components in the emissions, and retreatment of emissions is an effective supplementary measure. This is why many imported sedans all have emissions retreatment devices.

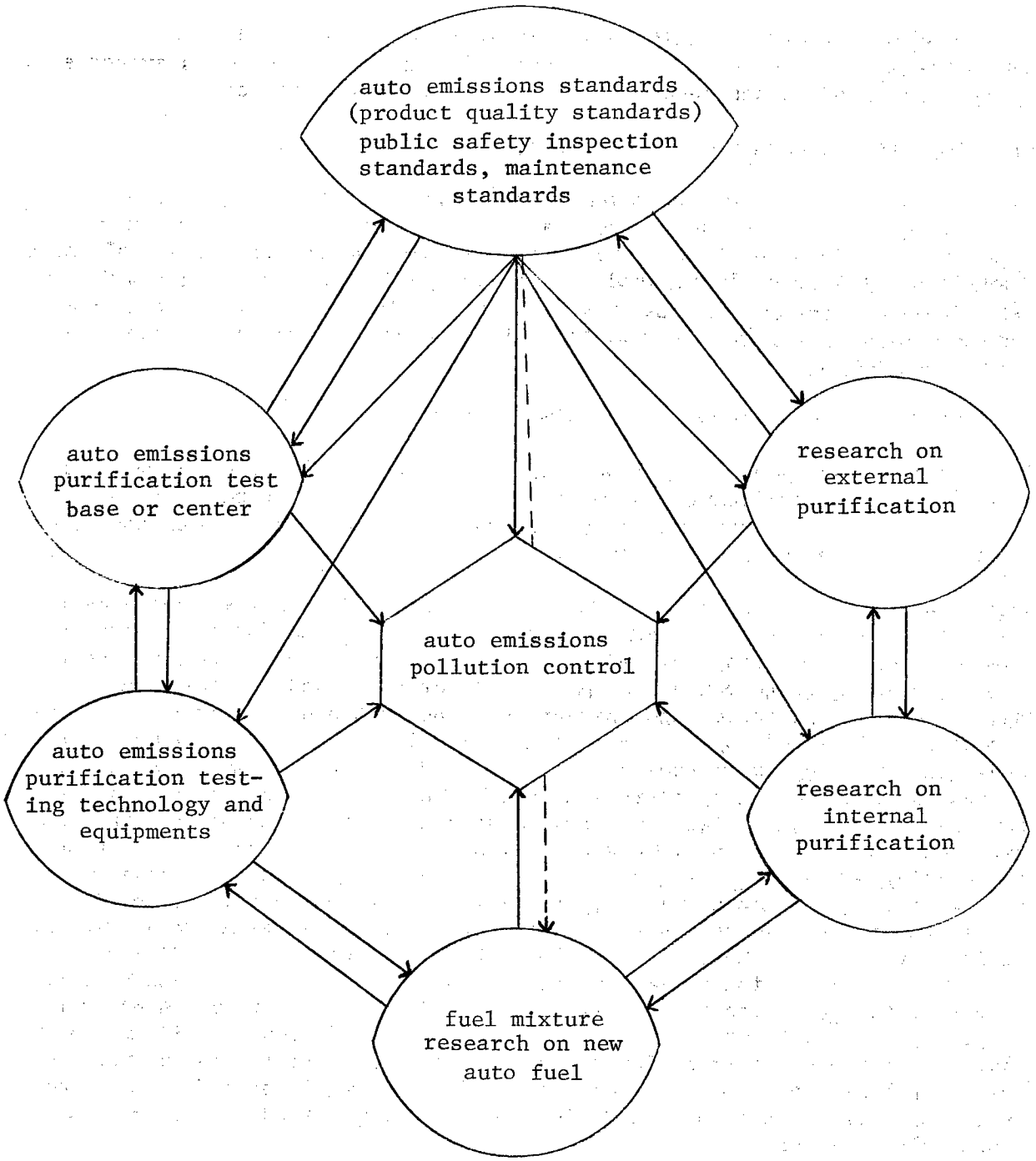


Figure 2. Diagram of auto emissions pollution control and comprehensive treatment.

External purification can be divided into the research of the manufacturing of catalyst and catalytic converters and their installation. For many years, we have cooperated with the Nonferrous Metal Research Institute of the Ministry of Metallurgical Industry in the research on rare earth catalyst. The catalyst's function is to lower the temperature of the oxidization of $2CO+O_2 \rightarrow 2CO_2$ and $4HC+5O_2 \rightarrow 4CO_2+2H_2O$ from 600° C to 300° C and to accelerate the reaction. As for the burning point of the hive-shaped catalyst produced, it is: CO < 150° C and 200° C for HC. The high-temperature resistant temperature is 900-1,000° C.

Catalytic converter. This is installed in the Jiefang model cars using a 600x200x150 (mm) rectangular box with electricity conducting input and output points. It is covered with a steel net stored with catalyst in particle form. Taking into consideration the reduction of resistance and the strengthening of the catalytic reaction, the catalytic converter is designed with a relatively large cross section, with 11.2L of catalyst inside.

The layout of the catalytic converter is determined in the following manner: first, the temperature field of the exhaust pipe is determined after gaining an understanding of various charts for different conditions and positions; next, determine the relation between the catalytic rate and temperature, and after considering the convenience of dismantling, maintenance and replacing the catalytic converter, the location is finally decided upon. In the Jiefang model vans, the converter is placed 1.5 m away from the main exhaust pipe.

The length of service of the catalytic converter depends on the catalyst itself; but it is also affected by the Pb, P, S in the gasoline and by the lubrication oil. Abrupt rapid rise in temperatures, over-concentrated air mixture, incorrect air burning ratio, misfire, overheating of the catalytic layer or vibrations of the catalytic converter will also reduce the effectiveness of the catalytic reaction.

Between 1977-1980, the domestic manufactured rare-earth catalytic converter described above was placed in a bus modified with a CA-10 B model chassis. After the bus had traveled 23,000 km, the purification rate of CO was 80 percent and that of HC 70 percent. After 48,000 km the catalytic converter was not damaged. The purification rate for CO was 68 percent and that of HC 64.9 percent. That device had little impact on the power and economy (N: -24 percent; ge: +1.7 percent) and the noise level was reduced 3~4 dB(A). It is now in commercial production.

External purification also includes the control of the quantity of lubrication oil in the crankcase and the amount of HC discharged. We can reduce the consumption of oil by 40 percent if we use a closed forced ventilation device. A device to prevent evaporation in the carburetor is still under study.

3. Research in Internal Purification

Internal purification involves improvements in the combustion process and this is one of the chief functions in new engine designs. There are many

aspects: improving the mix in the carburetor, selecting new carburetors, improving the amount of air to be distributed in the intake manifold (including the determination of the compression pressure, the explosion pressure, the amount of air intake distributed, the coefficient of air in the cylinders and the proportion of air discharged from the cylinders); increasing the compression ratio; improving the combustion chamber; improving the spark plugs and reducing the number of misfires; improving the distributor using high-powered ignition; using the over-injection of oil when idling or accelerating to cut off the oil saving device, and research on combustion with a thin air mixture.

Such tasks are very difficult to apply to cars in use. We had carried out only some experimental research on two of the topics in SH760 sedans, especially on the methods to adjust idling and acceleration and improved the carburetor's idling-acceleration fuel opening, main fuel opening, air opening, foam atomizer opening, air regulator valve (location) and studied the relation between ge and its discharge according to various speeds. The latter involved an experimental study of the angle of the idling-acceleration device screw, the position of the air-regulating valve screw, the degree of vacuum in the air intake, the lead angle of ignition and the adjustment of operating methods. We had also experimented with matching the increase in compression ratio from 7.4 to 8.1. After modifications, the rate of oil saving reached 10 percent and the discharge at idling-acceleration also attained international standards.

On the selection of new carburetors, we believe that West Germany's model K fuel ignition pump is more suited to our technical conditions and has a definite future.

As for the intake manifold, we had also tested the evenness of distribution in exhaust samples from the cylinders.

The improvement in the design of the combustion chamber is to curb explosion, raise the compression ratio, strengthen the air intake and raise the heat efficiency. Engines in China were largely produced in the 1950's and the compression ratio, about 6-7, is relatively low and there is also inadequate research in replica motors. For example, in saving fuel, we sacrifice power and in adjusting to road conditions, fuel is saved under partial-load operating conditions. All these show that engine designs in China have to be improved. At present, petroleum refining technology is improving in our country and it is estimated that beginning from 1985, No 85 gasoline will be available all over the country and this is beneficial to the development of new engines. Yet at the same time when the compression ratio and heat efficiency are being improved, we should, based on the demand for quality service, also conduct a series of studies on the thermal load, strengthening of parts and friction. The increase in the compression ratio may raise the average efficiency of the engine in China by 5-10 percent.

The improvement of individual parts and overall quality of the ignition and combustion systems include for example the improvement of the distributor and the material quality of the spark plugs, the reduction in noise levels

and the number of misfires and firing and the increase in the rate of combustion so as to control the amount of CO and HC discharged.

Tests have shown that if the high-powered non-contact ignition device is not matched with a thin air-mixture in combustion, there is no obvious result in saving fuel or reducing CO and HC discharge.

Many units in our country have conducted single cylinder tests in thin air-mixture combustion but they have not reached the stage of practical application.

4. Using Fuel Mixtures

Using a mixture of 1 percent hydrogen and 99 percent of gasoline for combustion with a relatively thin air-fuel ratio and under idling-acceleration operating conditions can produce even better results than pure gasoline. A comparison of two different combustion processes in engine number 680 of the SH760 sedan shows that under idling-acceleration operating conditions, the use of fuel mixture can save 25 percent of gasoline and CO and HC are reduced by 49 percent and 82 percent respectively. Therefore, the use of fuel mixtures is another new method to reduce pollution besides internal and external purification. The source of hydrogen can be taken care of easily. Based on our study, the discharge of hydrogen by the chemical, fertilizer and petroleum refining industries in China has been extremely wasteful. As for the safe storage of hydrogen, there has been encouraging progress in the development of metals for hydrogen storage. For example, such hydrogen-storage metals as those in the La Ni family, Ti Fe family, or Mg family, whether in activity, longevity, and the rate of hydrogen stored per unit weight, have all reached the application stage. The tubular hydrogen storage canister which we test-installed in engine number 680 of SH760 sedan had only the dimensions of a 150 tube and was smaller than the battery. Such a canister had about 10 kg of NiR_20 hydrogen storage metal and could hold 1.6 m^3 of hydrogen.

The reason why a fuel mixture can save gas and control emissions is as follows: the combustion of hydrogen has a big air-fuel ratio, i.e., it can burn within a ratio ranging from 4-75 percent and it has a rapid combustion ratio which is 5.85 times that of gasoline. Hydrogen is a non-carbon fuel and will not pollute. The combustion process of the fuel mixture lets hydrogen play a role in curbing the development of CO and HC, thereby reducing the amount of harmful components.

The hydrogen-storage material, with 20 times more storage capacity, is far superior to ordinary $PbSO_4$ storage battery. In fact, the use of metal to store hydrogen, or $PbSO_4$ storage battery to store electricity or fuel tank to store gasoline are all different types of energy storage. The hydrogen storage device is similar in size to the battery and it poses no difficulty in the design of the car. It is slightly more expensive than storage battery.

In sum, after further study and improvement, the burning of hydrogen-gasoline mixture can become an advanced and effective anti-pollution method.

III. Economic Results of the Technology

China possesses the technical power and should be able to solve the problem of auto emissions pollution. If all the measures are carried out, we can expect to obtain considerable economic and technical results.

1. In large cities where industries and population are concentrated, we can control the harm caused by auto emissions, including acid rain which is created by the catalytic reaction of CO, HC, NO discharge. People's health will be protected and respiratory diseases will be reduced.

2. There will be the actual guarantee of the implementation of the country's environmental protection laws and the standards limiting auto emissions.

3. Automobiles can better serve as a mode of transportation in cities and villages.

4. The ability of our auto exports to compete will be enhanced.

5. Capital investments related to emissions pollution in the development of cities (such as electric fans, motors and stations needed for forced ventilation in tunnels and highways and daily electric consumption) can be reduced.

6. Conserve energy and develop the use of new energy sources.

12380
CSO: 4008/54

EFFECTS OF AIR POLLUTION ON AGRICULTURE

Tianjin NONGYE HUANJING BAOHU [AGRICULTURAL ENVIRONMENTAL PROTECTION] in Chinese No 5, Oct 84 pp 13-17

[Article by Wang Jiaxi [3076 0857 3556]: "Effects of Air Pollution on Agriculture"]

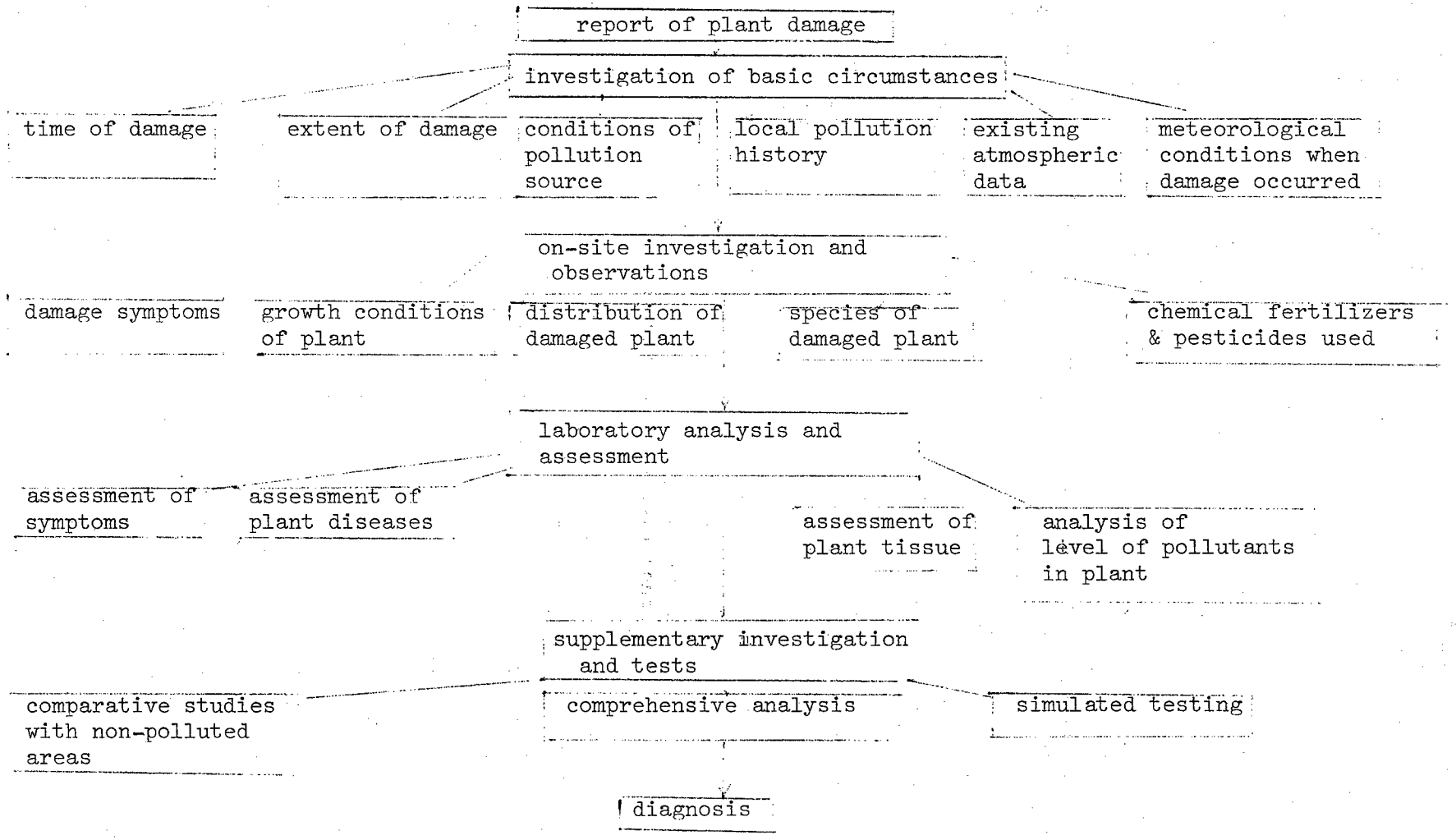
[Text] Many air pollutants, such as sulfer dioxide, hydrogen fluoride, chorine, nitrogen dioxide, ethylene, ammonia and ozone, affect crop growth and crop productivity. Moreover, some pollutants, including fluoride and heavy-metal particles, even accumulate inside vegetation and participate in the material cycle of the agricultural ecosystem, setting off a chain of adverse reactions.

The impact of air pollution on agriculture has been studied in foreign countries for several decades. In China, however, the subject began to be taken seriously only in the past few years. Below is an overview of the research developments, both here and abroad:

1. The Assessment and Diagnosis of the Damage of Air Pollutionon Crops

Since agricultural crops, trees and horticulture in the vicinity of certain factories frequently show signs of damage, how to identify and determine the cause of such damage and hence take appropriate prevention and treatment measures is a question that greatly concerns all of us. Harmful gases released from factories can cause acute injury to plants, resulting in visible damage. On the other hand, deceptively similar symptoms can also result from freeze injury, plant diseases and insect pests, lack of manure, lack of trace elements and the actions of pesticides and chemical fertilizers. Since 1970, the United States, West Germany, Japan and Canada have successively published symptom charts showing air pollution-related damage in plants. China put out similar charts in 1981. Based on its experiences in assessing and diagnosing over 100 cases of pollution injuries in crops and trees, the Jiangsu Botany Institute has come up with a fairly systematic assessment approach (see schematic diagram) which has demonstrated its practical effectiveness.

Schematic Diagram on the Assessment and Diagnosis of the Damage of Air Pollution on Crops, Trees and Horticulture



2. Threshold Limit Values of Main Air Pollutants for Plants

To establish agricultural environmental standards, it is essential that we understand the threshold limit values of the major air pollutants for plants. Some countries, for instance, enforce two kinds of standards: primary standards to protect public health and secondary standards to safeguard crops, livestock and wildlife. It is when we formulate secondary standards that we need data on threshold values as they relate to vegetation.

Through simulated fumigation and on-site tests in polluted areas in recent years, China has gained some preliminary knowledge of the threshold values of sulfur dioxide, hydrogen fluoride, cholorine and nitorogen dioxide, etc. Since our understanding is far from complete, we must carry out many more experiments before we obtain a more reliable basis for action. Threshold values in effect overseas are given in Tables 1 and 2.

Table 1 Threshold Limit Values of SO_2 for Plant Injury

Contact Time (hour)	Concentration Required to Produce 5 Percent Injury (ppm)		
	sensitive plants	average plants	resistant plants
0.5	1.0 - 4.0	3.5 - 10.0	≥9.0
1.0	0.5 - 2.5	2.0 - 7.5	≥7.0
2.0	0.3 - 2.0	1.5 - 5.0	≥4.5
4.0	0.15 - 1.25	1.0 - 3.5	≥3.0
8.0	0.10 - 0.75	0.5 - 3.0	≥1.5

Table 2 Threshold Limit Values of HF for Plant Injury

Contact Time	Concentration Required to Produce 5 Percent Injury (mg/cu.meter)		
	senstive plants	average plants	resistant plants
8 hrs	2.0 - 6.0	5.0 - 3.0	≥25
12 hrs	1.5 - 5.0	4.0 - 27	≥22
24 hrs	1.0 - 4.0	3.0 - 20	≥15
1 week	0.75 - 2.0	1.5 - 8	≥ 7
1 month	0.5 - 1.0	1.0 - 5	≥ 3
1 growing season	3.0 - 0.7	0.5 - 2	≥ 1
1 year	/	0.2 - 0.5	/

Most of these threshold values concern acute visible damage caused by high-concentration but short-term exposures. It is more difficult to determine the threshold values for low-concentration exposure lasting a longer period of time. Such research is now underway in China and elsewhere.

3. The Effects of Air Pollutants on Plant Growth and Productivity

Air pollution adversely affects crop growth and productivity. From field studies using simulated fumigation designed to find out the acute damage of high concentrations of sulfur dioxide, the Jiangsu Botany Institute learned the plants thus exposed suffer varying reductions in height and weight of their leaves and stems. They grow slower, take longer to blossom and bear seeds and, to various extents, have smaller yields.

1) Air pollution affects productivity differentially, depending on the stage of growth of the plant when exposure occurs.

The extent of crop losses is closely affected by the timing of the exposure. Cereal crops are most vulnerable during the flowing stage (Tables 3 and 4), (Jiangsu Botany Institute, 1976). Experiments conducted abroad also confirm that when crops, particularly cereal crops, are polluted in the flowing stage, the decline in productivity is most drastic. (Van Haut, 1961; de Cormis, 1972; Maly 1974).

Why crops are exceptionally sensitive to air pollution during the flowering stage has intrigued many researchers. From an experiment in which wheat was exposed to sulfur dioxide, Zhang Yaomin (1728 5096 3046) and others concluded that: 1) Fumigation during the booting and flowering stages causes a considerable number of pollen grains to degenerate and dissolve, inhibiting their germination and the prolongation of pollen tube and resulting in many allotype pollen grains. It is believed that this is one of the main reasons for the impaired ability of the wheat in the experiment to fertilize and bear seeds; 2) Injured egg cells and endosperm nuclei completely lose their normal physiological fertilizing function. This is an even more crucial reason why polluted crops exhibit a reduced ability to fertilize and bear seeds; and 3) Crops are more sensitive in the booting stage than in the flowering stage, suggesting that during the time from booting to flowering, crops are most vulnerable to sulfur dioxide. These observations and opinions are very valuable. Based on their experiments, Bonte and others (1982) pointed out that plants are most sensitive to fluorine during fluorescence when exposure can weaken their ability to fertilize. This comes about because of the accumulation of large quantitites of florides in the stigma of the pistil which inhibits the germination of pollen grains deposited on the stigma. To sum up, air pollutants can damage crop growth and fruition by way of foliar injury or directly attack the reproductive organs of the crops and interfere with fertilization and fruition.

2) Relationship between Foliar Injury and Crop Yields

Can crop losses occur without visible foliar injury? This question has been the focus of a long debate and no consensus is yet in sight. Some people hold that productivity can be lowered even in the absence of visible damage or symptoms. They argue that air pollutants can affect the foliar physiological process and hence productivity without damaging the tissues in the leaves. Besides, air pollutants can directly attack the reproductive process, which may be even more sensitive than the leaves.

Table 3 Differential Effects of SO_2 on the Yields of Rice in Varying Stages of Growth**

Fumigation duration (day)	Stage of Growth	Mean Yield Per Pot* gram	%	Empty, shrivelled grains (%)	Wt./1000 grains (gm.)
Control		126.3	100	14.0	21.2
6.6	tillering	79.8	63.5	22.0	19.4
6.22	booting	53.4	45.0	29.3	17.9
7.3	flowering	17.7	14.1	59.5	15.1
7.15	grouting	70.1	55.6	23.0	18.5
7.25	maturing	107.6	84.9	18.3	20.5

*Two pots per treatment. Each pot had 8 clumps, each clump 5 plants.
**SO2 was applied in a static state in a 33 ppm concentration.

Other researchers believe that foliar injury may not necessarily mean a drop in productivity. If exposure takes place early in the development of the plant, sufficient time exists for it to recover from the damage. (Jones and others, 1978). After 43 years of research in the vicinity of a copper smelting plant in the United States, Hasse and other (1980) concluded that: 1) Productivity losses do not occur when there is no visible damage; 2) The percentage of productivity loss is lower than the percentage of damaged area; and 3) Foliar damage may not necessarily lead to a drop in productivity.

Table 4 Differential Effects of SO_2 on the Yields of Wheat in Varying Stages of Growth**

Fumigation Duration	Stage of Growth	Mean Yield Per Small Plot* gm.	%	Mean no. of Grains per ear	Wt./1000 grains (gm.)
Control		864	100	43.6	27.6
3.19	tilltering	762	88.2	43.7	24.3
4.15	booting	573	66.3	44.2	22.3
4.26	flowering	392	45.4	17.6	25.8
5.23	maturing	730	84.5	43.2	24.1

*Two smalll plots per treatment. Each plot was 2 sq. meters.
**SO_2 was applied in a static state in a 35 ppm concentration.

In cases of acute damage, the extent of productivity losses is positively related to the percentage of damaged areas: the more extensive the foliar damage, the greater the productivity loss (Jiangsu Botany Institute, 1978). This statement only indicates a general trend, however. There still remains the much more complicated task of determining the quantitative relationship between damaged areas and productivity loss. As early as 50 years ago, Hill and Thomas (1933, 1935) put forward the equation, $y = 1 - bx$, to express the relationship between damaged area and productivity loss, in which

y = actual yield as a percentage of that of the control, x = the percentage of damaged area, b = productivity loss, in case of total foliar damage, as a percentage of the yield of the control and a = a constant near 100 percent.

This equation has come under criticism for failing to consider the fact that plants exhibit varying susceptibilities during different stages of development and that different species of plants have dissimilar characteristics (some are more resistant than others.) However, we have so far failed to formulate a more logical mathematical model.

In China today, air pollution still frequently causes acute injury to crops in industrial areas. It is therefore necessary for us to establish a mathematical model which projects productivity losses relatively accurately and assesses the relationship between the extent of foliar damage and productivity loss.

3) The Relationship between Threshold Doses of Air Pollutants and Productivity Loss

In recent years, extensive tests have been conducted in foreign countries to find out the relationship between the threshold doses of pollutants and productivity loss. Such a relationship, if known, could help us project productivity losses in crops, provided we know the extent of air pollution in a particular region or nation-wide.

a. Experiments in Polluted Areas:

Maly (1974) planted various crops in a 100-sq. meter experimental plot which he set up near a SO_2 pollution source. He monitored SO_2 concentrations in the air continuously (the average weekly concentration, he found, was 3.35 - 3.64 mm/cu. meter), and kept a record of crop yields. The percentages of productivity losses for the various crops were: potato (16.2); corn (16.7); oats (12.2); clover (15.5); linseed (28.3) and flax fiber (23.8). In a large-scale experiment, Guderian and others (1968) selected six points of various distances from a SO_2 pollution source and monitored the SO_2 concentration at each point on a continuous basis. They also compared the yields of almost 20 crops, obtaining very valuable data. They divided the SO_2 concentrations recorded into "monitored concentrations" (average concentration for the duration of the experiment) and "exposure concentrations" (the average value for all the concentrations recorded during the experiment which exceeded 0.10 ppm). It was found that for the most sensitive crop (potato), the critical concentrations affecting productivity were 0.21-0.23 ppm (exposure concentration) and 0.010-0.015 ppm (monitored concentration). Corresponding figures for the least sensitive crop (tomato) were: 0.31-0.57 ppm (exposure concentration) and 0.051-0.124 ppm (monitored concentration).

In field conditions, a gaseous pollutant varies tremendously in concentration over time. Crop yields may be affected only when the pollutant reaches a high enough concentration. Since measuring the average concentration value for an extended period of time does not necessarily reflect the real impact of concentration, a more logical step would be to measure only those concentrations which are relatively high.

b. Experiments using open-top chambers and field open chambers

Since the 1970's, researchers have been conducting experiments using various kinds of open-top chambers equipped with nonfiltered ambient air or charcoal filtered air. These techniques are better able to control the levels of gaseous pollutants, produce a closer approximation to natural conditions and are more suited for experiments involving long-term, low-concentration exposures. They also make it easier for us to quantitatively assess the dose-productivity loss relationship. Sprugel and others, for instance, carried out a 2-year test in 1978 using open field chambers and came up with this mathematical model for the SO_2 dose-crop loss relationship: $y = 0.803x - 0.003x^2$, in which y = the percentage of crop loss, x = SO_2 dosage, that is concentration (ppm) x time (hours).

To estimate and measure crop losses due to ozone, the United States has set up the National Crop Loss Assessment Network, linking research at 5 points. Each point is equipped with numerous open-top chambers. Important crops including soybean are grown in each location. They are exposed to filtered air (control), local air (the average ozone level in Northeast United States, for instance, is 0.04 ppm) and local air + ozone in concentrations of 0.03, 0.06 and 0.09 ppm on an extended basis. Nationwide crop loss data can be estimated by integrating figures from all network points.

4. The Movement of Air Pollutants in the Agricultural/Forest Ecosystem

Pollutants can accumulate, travel and circulate in the ecosystem, becoming increasingly harmful as they move around. This fact has been recognized by more and more people. Yet little research has been done on the movement and circulation of gaseous pollutants in the agricultural/forest ecosystem. The participation of atmospheric fluorides and heavy-metal particles in the biological cycle currently poses the following pollution problems in China:

(1) Atmoshperic fluorides - forage grass - the animal husbandry system

Forage grasses and crops absorb the fluorides deposited on their surface. As a result, their fluoride levels go up. After grazing on high-fluorine grass, sheep, cattle and other livestock develop fluoride disease. This pollution problem is fairly serious in Inner Mongolia, especially around the Baotou area. After several years of hard work the Baotou Environmental Protection Science Institute has come up with the following findings:

1) Local grass and crops contain an increased level of fluorine mainly as a result of absorbing a large amount of atmospheric fluorides. 2) High-fluorine forage grass is primarily responsible for transmitting the floride disease to livestock in Baotou. 3) Atmospheric fluoride pollution is the root cause of the fluoride disease among local livestock. 4) The threshold limit value of atmospheric fluorides for the maintenance of the ecological equilibrium is 1 mg/dm^2 . tian (the unit for lime filter paper).

(2) Atmospheric Fluorides - Mulberry - Silkworm

Mulberries develop fluoride disease after their leaves absorb and accumulate a large amount of fluorides emitted by some phosphate fertilizer plants and brick and tile factories. Moreover, the excrements of silkworms and fluorides stored in decomposed high-fluorine mulberry leaves are further diffused in the agricultural/forest ecosystem. Studies by the Jiangsu Botany Institute show that fluoride levels in silkworm leaves exceed 30-40 ppm, high enough to cause acute fluorine poisoning in silkworms. As a result of the widespread use of brick kilns in rural areas in recent years, the tension between fluoride pollution and the production of silkworm mulberry has been intensified. This is a problem which must be examined and resolved.

(3) Atmospheric heavy-metal particles - crops - the human and livestock system

Particles released by some smelting works contain a variety of heavy metals. They are deposited on the leaves of crops or on soil, where they make their way into the vegetation through the leaves or roots. From there they are carried into the bodies of humans and animals, jeopardizing their health. From its study on the environment surrounding a smelting plant and other experiments using simulated pot culture, the Jiangsu Botany Institute confirmed that leaves can directly absorb heavy metals in particles deposited on them and thus constitue the main route for the entry of those metals into the human body, with adverse effects on human health. Because heavy metals leave crops themselves largely unscathed and do little visible damage to leaves, we cannot easily discover their hazards. It is time we took note of them.

5. Future Research Prospects

Agricultural environmental protection is a new science, of which research on the effects of air pollution on agriculture is a particularly weak link. Much research remains to be done. In light of China's present circumstances, we should focus on the following.

(1) The effects of acute injury on crop yields. At present acute injury to crops is rather serious and will remain so for some time to come. While its assessment and diagnosis, on the whole, no longer present a problem, we still have to explore ways of establishing a scientific model to project calculate losses.

(2) The effects on crop yields of low-concentration long-term chronic injury. This is the direction research overseas is headed for and China should also double its efforts here. We should make use of appropriate techniques and methods involving field studies, fixed point comparison and simulated fumigation (open-top chambers) to gradually establish a dose-productivity model (for a variety of gases, various species and different stages of growth).

(3) Threshold limit values of the main harmful gases for crop injury, including those that result in a 5 percent foliar injury and productivity losses. Such data should serve as a reliable scientific guide when we formulate air quality standards affecting agriculture.

(4) The synergistic effects on crops of a number of gaseous pollutants. A relatively common combination in China today is SO_2 + HF. SO_2 + ethylene. SO_2 + heavy metals. We must try to learn more about the nature of their combined effects and threshold limit values.

(5) The effects of air pollutants on the reproductive process in crops (the germination and differentiation of pollens, pollination, fertilization, pistil, fruition).

(6) The effects of particulates (dust, particles) on plant growth, flowering and fruition, an issue which has given rise to many arguments in agricultural practices. Through research we should try to answer the question whether or not particulates affect photosynthesis, gas exchange, pollination and fertilization.

(7) Research on plant resistance. We should increase our understanding of the resistance of different species of crops to various air pollutants and identify ways to increase such resistance.

(8) Research to prevent crops from being damaged by air pollutants, including crop distribution, the spraying of protective agents and leaf washing.

(9) The movement of air pollutants in the agricultural ecosystem and the consequent hazards; prevention and treatment.

(10) The injury mechanisms of air pollutants in crops and the resistance mechanisms of crops.

12581
CSO: 4008/156

ECOLOGICAL PRINCIPLES APPLIED IN DEVELOPING INDUSTRIAL ZONES

Tianjin NONGYE HUANJING BAOHU [AGRICULTURAL ENVIRONMENTAL PROTECTION] in Chinese No 5, Oct 84 pp 25-27

[Article by Xu Daolan [1776 6670 5965]: "Applying Ecological Principles in the Development of Industrial Zones Outside Cities"]

[Text] As natural resources are being destroyed and environmental pollution worsens with each passing day, the most reliable way to ensure environmental protection, economic prosperity and optimal productivity is to apply ecological principles in the rational development, management and protection of natural resources, maintain the ecological balance and devote attention to the relationship between economic development and environmental protection.

Ecology is concerned with the relationships between organisms and their environment. An ecosystem is the basic functional unit in the biosphere and the material foundation for stabilizing its energy storage. It refers to a structured, specific functional unit that includes the material cycle, energy flow and information transmission between the biosystem and the environmental system in a particular area on the face of the earth. An ecosystem comprises both the natural ecosystem and the social ecosystem. Within each system, there is a number of factors. The transmutations of a factor affect not only other factors in the same system but also the other system. When we study any single issue in environmental science, therefore, we must bear in mind the objective fact that the natural ecosystem and the social ecosystem are closely related to and interact with each other. Only thus could we accurately reveal the complexities of reality.

As the national economy continues to grow, some factories in densely populated cities, which had been serious polluters in their environments, and other factories earmarked for expansion, have successively been relocated from the inner cities. Meanwhile, several industrial zones have appeared in the suburbs. One such zone is the Dananhe industrial zone in the western suburbs of Tianjin, which was first created in the lat 1960's and now comprises 14 factories on 1,400 mu of land.

Situated in the western suburbs, the industrial zone is surrounded by the farmland, vegetables, forests and fish ponds of 18 villages. Both production and domestic water supplies come from underground. Sewage drains into the

nearly Sizhi Canal. As the main production artery in the entire rural area, the canal rises from Laishuihe River in the north and flows 13 li into Duliujianhe River in the south. We believe that the ecosystem of an industrial zone in the suburbs of a large city should be one which revolves around people and merges nature with society. With a complex structure and organization, its is a comprehensive system combining key elements in the natural environment (atmosphere, ground water, surface water, soil, etc.) with those in the social economy (industry, agriculture, commerce and transportation) and the cultural scientific system.

Its structural unit is formed by joining the structural unit in the natural environment with a specific socio-economic and cultural complex. Different structural units perform different functions. Over time, the various structural units become organically and intricately interwoven with on another, forming an integrated ecosystem. Within the system, human beings interact with the environment through their production and consumption activities. For its part, the environment also affects human production and living. Human beings require a large and stable supply of energy to improve their standard of living. To ensure this supply, apart from the natural material flow and energy flow and their man-made counterparts, people also depend on the transmission of information (science, technology, policies and laws) to control and regulate the directions of material flow and energy cycle within the ecosystem and the directon and intensity of their interchange with the flow of material and energy outside. The result is a superior low-consumption, high-efficiency ecosystem.

The Dananhe industrial zone currently has 9,516 workers and 3,000 residents, while the villages surrounding it have 20,400 people. A total of 55,000 mu is under cultivation. In 1983, total industrial and agricultural outputs were worth 136.07 million yuan and 35.35 million yuan, respectively. Agricultural products include rice, wheat, millet, various kinds of vegetables, fish, poultry, etc. Since the Third Plenary Session of the Eleventh Party Central Committee, the rural economy has made considerable progress. Besides grains, vegetables, fruits, sideline business and fishery, many small-town enterprises have come into existence. There are at present 117 factories in the entire area, employing 4,000 people.

In the past, factories were relocated to rural areas of expediency, not in accordance with natural laws or economic principles. Factories were solely concerned with industrial production and villages, with food production. Other than geographical proximity, they had almost nothing to do with each other. But the laws of nature soon linked them together. As production increased and output value grew over time, so did environmental pollution. Industrial sewage, laden with numerous pollutants, were discharged into the Sizhi Canal, on which the entire village's agricultural, forestry and fishery industries depend for water. The limpid, greenish waters of Sizhi Canal have become turbid and multi-colored, showing shades of yellow, white, red and purple. The deterioration is most market during Spring, when little rain falls. The yield of wheat fields irrigated with the polluted waters of the canal generally drops one third. In 1983, 50 percent of the crop died after 500 mu of paddy fields in Niutuozi village were irrigated with polluted waters. In the

same year, one third of the fish fry in the 100-mu fish pond in Niutuozi was killed after sewage was drained into the pond. The factory paid 20,000 yuan in compensation. In April 1984, the waters in the 2,000-mu fish farm in Tananhe village were so polluted that 20 percent of the fish died. Even more serious is the increasing incidence of cancer among residents in Majiasi, Daquanzi, Xiaoquanzi, Dakuanhe and Xiaokuanhe villages. (These villages have also been affected by the drainage from the Tianjin Petrochemical Main Plant.) The river course rose by 0.5 meter in just 1 year due to the depositing of a large volume of suspended matter. It went up another 2.5 meters in only 6 months because of the sewage discharged by the factories, seriously affecting the water flow from north to south. It takes 20,000 yuan to have the river course cleaned. All these facts demonstrate that the excessive pursuit of economic results in violation of the laws of nature and economics would ironically lead to grave economic losses.

Some Views on the Development of Urban Industrial Zones

1. We should plan the relocation of some industries to the suburbs and arrange the distribution of industry and agriculture rationally, taking into account the special environmental features and natural resources of the different localities. To do this, we should set up an integrated leadership organization which would include the surrounding villages. We should make full use of factory facilities, advanced technology, rich rural resources and labor force to create a large complex ecosystem in which agriculture, industry, animal husbandry, sideline business, fishery, transportation, commerce, education and culture can be developed comprehensively.

2. Within this system, we should exploit diverse technologies to improve the conversion rate of solar energy, the utilization rate of bioenergy and the recycling rate of waste materials, thereby accelerating the material flow and the energy cycle, increasing productivity and reducing environmental pollution.

3. As soon as possible, we should reverse the trend, existent for several years now, under which most raw materials and primary products are siphoned off to the cities and little goes to the suburbs.

4. The command system is a linchpin in the production system, consumption system, distribution system, circulation system and the socio-economic administrative system. Consequently, we should follow the spirit of the Twelfth National Party Congress and set up a modern, knowledge-intensive socio-economic administrative system by tapping available talents so that it could be the true master of the ecosystem.

In short, ecological principles show that in the objective world, productive forces are unleashed when we harness the interactions among the constituent parts of an ecosystem. The system is most productive when it achieves a state of equilibrium. By following systems engineering principles, we can put together human, material and economic resources most beneficially and reclaim material resources from nature from a systems perspective. This would enable us to carry out multi-activities and practice comprehensive

utilization in a complex ecosystem like the urban industrial zone and scientifically organize the flow of a wide range of material resources and the energy cycle, transforming the ecosystem into the best industrial-agricultural ecological model, one which would remain relatively amenable to human control and meet the needs of both human existence and social development.

12581
CSO: 4008/156

RESEARCH AREAS IN AGRICULTURAL ENVIRONMENTAL SCIENCE OUTLINED

Tianjin NONGYE HUANJING BAOHU [AGRICULTURAL ENVIRONMENTAL PROTECTION] in Chinese No 5, Oct 84 pp 18-20, 4

[Article by Fu Kewen [0265 0344 2429]: "Agricultural Environmental Science Flourishes in China"]

[Text] Agricultural environmental science, a new integrated discipline, emerged in China in the 1970's following the development of agricultural environmental protection. For the past 10 years, both the fastness of its development and the amount of data it has collected have been spectacular.

Agricultural environmental science studies the impact of human activities (including production and living activities) on the agricultural environmental quality and the agricultural ecosystem and their protection and improvement. An integral part of environmental science, it is also an important branch of agricultural sciences. It not only involves ecology, environmental biology, environmental chemistry, environmental geoscience, environmental engineering, but is also closely related to soil agrochemistry, plant protection, crop breeding and cultivation, genetic breeding, animal husbandry and veterinary science, agricultural meteorology and agricultural economics, etc.

Agricultural environmental science research in China dated from 1971. Before then, despite a fair measure of success in the agricultural utilization of the "three wastes" (waste gas, waste water and industrial residue) of industry, sewage irrigation and the safe use of pesticides, research in this field generally remained sporadic and lacked overall planning and organization. The purposes and contents of research were not closely related to the protection of the agricultural environmental quality. Reflecting on the serious environmental pollution problems at home a abroad, Premier Zhou Enlai far-sightedly told comrades in the Ministries of Agriculture and Forestry in December 1970, "Environmental pollution is a new problem for us, one which will get worse as we industrialize. The Agriculture and Forestry Ministries should put this problem on their agenda: agriculture and forestry need both air and water." To reduce the damage that environmental pollution might do to agricultural production, the former Ministry of Agriculture set up in 1971 the Fourth Research Office (namely the Agricultural Environment Research Office) dedicated to the protection of the agricultural environment. The new office became part of the Agrobiology Research Institute under the then Chinese Academy of

Agricultural and Forestry Sciences. As one of China's earliest environmental protection research organizations, it immediately began work on an agricultural environmental pollution survey and other projects in sewage biological purification and sewage irrigation, among others. In 1973, agricultural environmental science was for the first time included in the state agricultural scientific research plan. Agricultural environmental science took another step forward with the convening of the national scientific congress. In 1978, environmental protection research became part of the national long-range plan for science and technology. One year later, the Environmental Protection Research Monitoring Station was established on the basis of the Agricultural Environmental Reserach Office in the old Agrobiology Research Institute. The monitoring station was placed directly under the Ministry of Agriculture, Livestock and Fisheries. In addition, several specialized institutes under the Chinese Academy of Agricultural Sciences and the State Aquatic Products Bureau have successively set up environmental protection research offices (sections). The Beijing Academy of Agricultural and Forestry Sciences has established an agricultural environmental protection research institute, a move duplicated by academies in other localities including Shanghai and Tianjin. In 1983, the Agricultural Environmental Monitoring Station was established under the Ministry of Agriculture, Livestock and Fisheries. At present, the agricultural departments (bureaus) of over 10 provinces, municipalities and autonomous regions have set up similar monitoring stations. Zhejiang Agricultural University has set up a department of environmental protection. At the same time, numerous scientific research workers are engaged in agricultural environmental scientific research at the Chinese Academy of Sciences, the urban-rural construction and environmental protection system, the sanitation system and at institutions of higher education. Together they constitute a formidable agricultural environmental scientific research contingent. Furthermore, to strengthen academic exchanges and the transmission of information, we have established the China Agricultural Environmental Protection Association and the All-China Scientific and Technical Information Network for Agricultural Environmental Protection and put out the "Agricultural Environmental Protection" and "Overseas Agricultural Environmental Protection Development." A fairly sound agricultural environmental protection system is now taking shape.

After a decade of struggles by the broad ranks of scientific researchers, agricultural environmental scientific research has achieved a number of significant results, which have helped increase agricultural production and improve the ecological environment. Many of these achievements have been applied to production, with marked economic and environmental results, laying the foundation for the development of agricultural environmental science.

Agricultural environmental pollution in more than 20 provinces, municipalities and autonomous regions has successively been surveyed and evaluated. These investigations focused on pesticides pollution in key rice, wheat, tobacco, fruit and vegetable growing areas and pastoral areas; fluoride pollution in important pastoral areas; heavy-metal pollution in grains and soil in certain areas in southern China; nitrate contents in vegetables in the Beijing region; and water pollution that threatens fishery resources in lakes, rivers and main coastal waters. On the basis of these studies, the Environmental

Protection Office, Ministry of Agriculture, Livestock and Fisheries compiled the nation's first "Report on Agricultural Environmental Quality" (Certain Areas) in 1982, analyzing trends in agricultural environmental pollution and putting forward a strategy to improve China's agricultural environmental quality. In 1976, the Ministry mobilized over 200 scientific research units nation-wide to undertake a 6-year general survey on environmental pollution affecting 3 kinds of farmland totalling 5.69 million mu in 37 sewage-irrigated areas. A pollution index was adopted to evaluate farmland pollution and recommendations were made to carry out sewage irrigation scientifically. Also completed was a preliminary study on the background value of 8 elements found in certain agricultural soils and food grains in 13 provinces and municipalities, including Beijing, Shanghai and Zhejiang. This study, now followed up by more in-depth research, has provided a frame of reference for the development of agricultural environmental monitoring and environmental quality evaluation.

Concerning environmental standards research, after many years of cooperation among scientific researchers, China has formulated its first "Water Quality Standards for Farmland Irrigation," "Water Quality Standards for Fishery," "Control Standards for Hazardous Substances in Agricultural Sludge," "Standards for the Safe Use of Pesticides," and "Santitation Standards for Poultry Feed." The first four sets of standards have been approved as national environmental protection standards and adopted by the Ministry for nation-wide application. Three of them were awarded first prize by the former Ministry of Agriculture and the State Aquatic Products Bureau in their annual scientific achievement awards. In the course of setting these standards, scientists examined the impact of scores of enviromental pollutants on crops, vegetables, livestock, poultry, fish, agricultural soil and the entire agricultural ecosystem. Their research contributed to the protection of agricultural, livestock and fishery resources and the prevention of agricultural, pastoral and aquatic pollution, as well as provided a basis for the formulation of environmental standards.

Much progress has also been made in pollution ecology research. Areas of investigation include the impact on such agricultural ecosystems as paddy fields and dry farmland of organic chlorine pesticides; the hazards of heavy metals, including cadmium and mercury, and their organic and inorganic pollutants, towards the sewage (or sludge)--soil--crops system, their effects on the system's laws of migration and transformation and prevention and treatment; the effects of atmospheric pollutants such as sulfur dioxide on the growth, development and yield of crops and on reproductive cell differentiation and fertilization in crops; the hazards of fluoride gases towards the mulberry--silkworm system and the forage grass--livestock system and their prevention and treatment; and nitrate pollution in vegetables and preventive measures. Satisfactory progress has been achieved in all these areas. Moreover, notable results have been obtained in such research as the Shijiazhuang Xisanjiao oxidation pond and the Qiqihaer sewage sludge control project, breaking new ground for the utilization of sewage resources in accordance with local conditions.

Along with pollution surveys and the formulation of environmental standards, research was also begun on analytical testing methods for pollutants in

agricultural samples. Such methods have now been established for many pollutants in agricultural and livestock products and soil, including several which have been adopted by the state as standard methods of analysis.

After the 12th National Party Congress, agricultural environmental scientific research has expanded from simple pollution prevention to studies embracing the entire agricultural ecosystem, propelling agricultural environmental science towards deeper and broader terrain. The main reason why agricultural environmental science managed to develop fairly rapidly within a relatively short time is its insistence on relating scientific research to economic construcution and serving agricultural production. Upholding scientific research cooperation, it has mounted joint efforts cutting across subject boundaries and involving many units.

Today, environmental pollution still rages on in China and ecological destruction has not been put under effective control. We have yet to understand many theoretical and practical issues in agricultural environmental science or put together a set of preventive and treatment measures that are effective and economically feasible. The development of agricultural environmental science has failed to keep pace with the demands of economic development. Absolutely speaking, agricultural environmental science has been maturing quite fast. Compared to other disciplines, however, it is a new branch of learning very much in its infancy and still exploring its objects of study, contents and research methods. Our future agricultural environmental research should be based on China's actual circumstances and focus on applied technologies that would prevent environmental pollution and ecological destruction. Resources should be concentrated on topics with obvious economic and environmental results so that a breakthrough can be achieved within 3 to 5 years, thus paving the way for economic revitalization and environmental construction. We must formulate an overall plan to take in the variety of agricultural environmental pollution problems that may appear at the end of the century, paying particular attention to the following areas:

1. Research on agricultural environmental quality surveying, monitoring and evaluation. By and large, our work in this area is still relatively weak; standards are low and we have not been able to meet the needs of environmental protection. Looking ahead, apart from continued efforts to survey and monitor agricultural environmental pollution and ecological destruction, we must strengthen research on the theories and methods of agricultural environmental quality evaluation to identify the best evaluation method for the agricultural environmental quality evalaution to identify the best evalaution method for the agricultural environmental quality of a particular type of locality. We msut undertake research on the background value of the agricultural environment and regional agricultural environmental capacity. With these studies as our basis, we should evaluate the current regional environmental quality of China's key agricultural and pastoral regions and make future projections. We should also do a good job in assessing the agricultural environmental impact of factories, mines, small-town industries, the exploitation of natural resources and the introduction of certain agricultural practices in key agricultural and pastoral regions.

2. Research on the effects of environmental pollution on agricultural production, the agricultural ecosystem, and the laws governing the migration, transformation, accumulation and metabolism of pollutants in the agricultural ecosystem. Research topics should including the effects of the following on poultry and on farmland soil quality: various atmospheric pollutants, sewage, sludge, other solid wastes, the main pollutants in fertilizers and chemical substances including pesticides and chemcial fertilizers; measurement and evaluation mehtods of losses of agricultural and livestock output; the residual laws of toxic substances in crops, livestock and soil; and the effects of environmental pollution on the structure, functioning and stability of the agricultural ecosystem. We must take special note of international environmental issues, including the impact of acid rain on agriculture, livestock and fisheries. While we must continue to study certain acute pollution problems, we should also investigate the synergistic effects of a combination of pollutants and the chronic effects on agricultural products of long-term low-consistency actions.

3. Research on agricultural environmental quality standards and control stanstandards for pollutants. We need more standards than what we have already formulated and promulgated; accordingly we should initiate research and standard-setting work for "Farmland Soil Quality Standards" and "Farmland Atmospheric Quality Standards." As far as the control of pollutants is concerned, we should formulate "Sanitation Standards for Livestock Feed (Forage Grass)." These should be on-going research to beef up the various standards which have been promulgated by adding new items and continuously revising existing ones. All localities should also try to work out their own.

4. Research on comprehensive prevention technology and ecological engineering measures to prevent and treat agricultural environmental pollution. Although factory treatment is vital to pollution prevention and treatment, comprehensive off-site prevention and treatment remains indispensable to protecting the agricultural environment. This reasearch area includes investigations into the oxidation pond--farmland system; the mechanisms and effects of organic sewage biological purification; the recycling of organic wastes; improving the results of oxidation pond purification; the technology of scientific sewage irrigation; the prevention and control of plant disease and the reduction of pesticide pollution by ecological agricultural measures; biological control and the rational use of pesticides; the selection and cultivation of resistant crop varieties; the rational distribution and planting of crops in accordance with the characteristics of the polluted area, thereby minimizing the hazards of atmospheric pollution towards agriculture; technology for the safe use of various solid wastes and fertilizers; and the restoration of seriously polluted farmland.

5. Research on ecological agriculture. Ecological agriculture is a new agricultural production model based on ecological principles. Although it cannot solve all pollution problems in the agricultural environment, it play a very important part in protecting natural agricultural resources, preventing ecological destruction, reducing pollution, and increasing the conversion rate of solar energy, the utilization rate of bioenergy and the recycling rate of agricultural production wastes so that agriculture, livestock and fisheries can

develop in a positive, renewable manner. We should undertake research that would adjust and optimize the structure and functioning of the agricultural ecosystem and development intervention strategies that would bring about a high-yield, good-quality and low-consumption man-made ecosystem. Bearing in mind China's specific circumstances and the natural conditions of the localities, we should further study, sum up, improve and popularize the various ecological agricultural models fashioned to suit local conditions.

6. Research on agricultural environmental monitoring technology and pollutant analytical testing methodlogy. Monitoring technology research mainly includes the principles and methods of sampling, the preparation of the sample, the method of quality control analysis (including standards and standard samples, and environmental monitoring standards), statistical monitoring methods and the applications of computer technology in agricultural environmental monitoring. Of particular importance is research on biological monitoring technology (including the screening, selection and application of eucone with practical value). Concerning analytical testing methods for pollutants as possible as soon as we can. Moreover, we should improve existing analytical testing methods, paying special attention to fast, accurate and continuously automatic analytical testing technology (including the research and manufacture of instruments), but without losing sight of simple technology more suited for widespread use by grassroots units.

7. Research on agricultural environmental management. Our present focus should be the methods, techniques and directions of the management of agricultural environmental protection. In particular, we should investigate how environmental analytical method and economic results can be used to strengthen management. There should be an overall analysis and evaluation of the miscellaneous impacts of industrial and agricultural activities. We should strengthen forecasting, taking special note of the potential agricultural environmental impact of the world's new industrial revolution so that solutions can be worked out in advance. We should examine the use of administrative and legal means to control agricultural environmental pollution and destruction and the formulation of relevant laws, regulations, standards and policies. We should also research the methods and procedures of agricultural environmental regionalization and planning and launch pilot projects in key areas.

12581
CSO: 4008/156

HISTORY OF ENVIRONMENTAL SCIENCES SOCIETY REVIEWED

Beijing ZHONGGUO HUANJING KEXUE [ENVIRONMENTAL SCIENCES IN CHINA] in Chinese No 1, 21 Feb 84 pp 4-9

[Article: "Historical Review--The Founding and Development of the China Environmental Sciences Society"]

[Text] The China Environmental Sciences Society is a young society of less than 5 years old since its founding in March 1979. In the last 5 years, under the leadership and support of the General Office of the Environmental Protection Leading Group of the State Council, the Ministry of Urban and Rural Construction and Environmental Protection and the China Scientific Association, we implemented the spirit of the directive of the party Central Committee, relied on the enthusiasm of the broad masses of environmental scientific and technological workers, and did a large volume of work in organizing academic activities, launching international academic exchange, popularizing science, and getting involved in editing and publication, environmental education as well as organizational building. We rendered definite contributions to raising our country's environmental scientific and technological standards and to promoting our country's cause of environmental protection.

The Role of Development, Promotion and Advancement

In the last 5 years, the work of our society could be divided into two stages. Prior to 1981, the society was in a stage of organizational building. In the 3 years during that stage, the various branches and special committees of the national society were successively organized and established, and societies were also established one after another in the various provinces, municipalities, autonomous regions and major cities and sectors. All kinds of activities were launched while organizational building was taking place. Since 1982, particularly after the 12th party congress, revolving around the strategic goal and strategic focus of our country's modernization, the society has launched more academic discussions on comprehensive and major issues as well as other activities. Looking back on the path which we have traversed in the last 5 years, the activities of the society has played a role of developing, promoting and advancing the development of our country's environmental science and technology and the cause of environmental protection.

1) Through academic exchange, we have promoted the development of environmental science and technology and the cause of environmental protection.

Academic activity is an important form of activity in developing environmental science and technology, raising the academic standards of the scientific and technological workers, and enabling science and technology to serve economic and social development. In the last few years, our society has organized a total of 56 academic activities at home, involving roughly 4,000 participants. We have exchanged nearly 3,000 theses, many of which were of definite academic level and practical value and were regarded with importance by domestic and foreign scholars. They promoted the development of environmental science and technology.

We have paid attention to integrating academic activities with the reality of environmental protection work, put forth many ideas and suggestions for the administrative departments, and promoted the development of the cause of environmental protection. For instance, the Environmental Control Society has held academic discussions on many occasions, during which valuable propositions have been put forth on the work of environmental control. In 1980, the First Academic Discussion on Environmental Control focused on the problem brought about by improper control, which was the primary reason for environmental pollution in China. For the first time, it proposed that we must "put in the foremost position of importance environmental control in the work of environmental protection." Later, at the discussion on the assessment criteria for environmental protection in enterprises, it put forth the methods for trial-implementing the assessment criteria for environmental protection. It has won the attention of the environmental control departments of various localities and brought into play its positive role in strengthening environmental control. Most of the theories, principles and methods put forth on several occasions by the Environmental Control Society on environmental control have been adopted and applied by the control departments. In July 1982, with the support of the State Planning Commission, our society and five other societies, including the Research Society for Natural Resources and the Ecological Society, jointly convened a discussion on the strategy of national land management. We carried out discussions on the principles and tasks of national land management, the goal to be reached by the end of this century and the major management projects which we must emphasize, and put forth references and opinions for the state in its effort to formulate strategic policy decisions. Our society and other societies also jointly convened other academic discussions on the issue of sewage irrigation and the environment, the conversion of powdered coal into a resource, and the utilization of solid discarded materials. They have all won the attention of concerned departments. Some of the propositions have already been adopted.

The academic activities were also closely integrated with the assistance to enterprises in solving specific problems involving pollution treatment. For instance, the Environmental Engineering Society and the Metals Society jointly convened a meeting on electric stove dust removal. Prior to the

meeting, they organized personnel to carry out investigation in over 100 factories, sum up technological problems, put forth targeted propositions, and succeeded in solving the practical problems of some factories. They not only promoted pollution treatment but also raised the reputation of the society.

The societies of many provinces, municipalities and sectors have also launched academic activities in line with reality and scored relatively good results. The Liaoning Provincial Environmental Society joined with other relevant societies to handle the rational utilization and development of water resources throughout the province. The Shenyang and Fushun societies carried out study on the pollution of the Hun He. The Fujian Provincial Environmental Society successively looked into the treatment of environmental pollution in Sanming City, Fuzhou City and Xiamen City. The Gansu Provincial Environmental Society conducted a comprehensive study of the environmental issues of Tianshui Prefecture. The Henan Provincial Society carried out study on the Shaolin Temple. In doing so, they all organized specialists and scientific and technological workers to carry out on-the-spot investigations and to put forth scientifically-based ideas and propositions, which were given due attention to by the local government, the concerned departments and the State Council. The Anhui Provincial and Guangzhou Municipal Environmental Sciences Societies have scored outstanding results in launching academic activities, and have been commended by the provincial and municipal scientific associations.

2) We have launched international academic exchanges and established ties with some international academic organizations.

In the last 5 years, our society has participated in international academic conferences on 4 occasions and has convened bilateral and international academic exchange conferences at home as well as invited foreign scholars to lecture in our country on 30 occasions. These activities have played a positive role in enhancing the exchange between the environmental scientific and technological workers of our country and those internationally, in borrowing from advanced experiences abroad, and in raising the standards of environmental sciences in our country.

In November 1981, our society joined the Chinese engineers delegation in attending the Eighth Congress of the World Federation of Engineers. We also attended the conference convened by the engineering and environmental committee of the World Federation of Engineers in Moscow in June 1983. In addition, in the name of our society, we took part in the World League for Protection of Natural Resources and the World Wild Life Foundation. Our society also established ties with the society for promoting sciences in the United States and the society for human environmental research in Japan.

In September 1981, the China-U.S. Environmental Sciences Forum was held in Beijing, five specialists on environmental issues from the United States and 45 individuals from our country participated. Our society put forth six academic reports and obtained 59 copies of technological materials. These

academic exchanges and forums have enabled us to have a more systematic understanding of the comprehensive regional environmental planning, land use, air quality assessment and the research methods involving groundwater pollution in the United States, and have inspired us in our work.

In October 1983, Professor (Jia Teng Yi Lang), chairman of the Japan Society for Research on Human Environmental Issues and former Chancellor of the University of Tokyo, personally led a delegation of eight people to take part in the China-Japan Academic Discussion on Environmental Laws. The two parties carried out relatively all-round discussions on the system of environmental laws, the system of assessing environmental impact, the "three simultaneous efforts" management system of construction projects, subsidies and fees for treating pollution as well as the system of legislature involving nature protection, and both parties made gains accordingly.

3) We have actively launched activities to popularize science and propagate and popularize the knowledge of the environmental sciences in society.

Toward the end of 1979, at the first conference on the work of popularizing science, we put forth the proposal to make March 1980 a national environmental protection propaganda month. This was approved by the leading comrades of the State Council. The former general office of the environmental protection leading group of the State Council and the society organized a joint office to launch nationwide effective environmental protection propaganda activities. Many veteran professors and the broad masses of scientific and technological workers warmly supported and actively participated in the activities. The RENMIN RIBAO and other newspapers of the central authorities published editorials, commentaries and articles and the Central People's Broadcasting Station held forums on 15 occasions on the knowledge involving environmental sciences. Incomplete statistics show that the newspapers at and above the provincial level have published 649 articles of all kinds, and 11 local newspapers below the provincial level have published some 1,300 articles and reports in this regard. The activities in the propaganda month have mobilized the masses and promoted the large-scale popularization of the knowledge in the environmental sciences.

The popularization of the technique of treating environmental pollution is an effective form of scientific popularization in line with the reality in production. In May 1982, our society joined the Shanghai Environmental Society and the Environmental Protection Service Department of the Shanghai Municipal Electromechanical Company to hold in Shanghai the first national "technological exchange and sample order conference on environmental protection equipment and apparatuses." There were 211 units displaying 589 acts of 322 kinds of equipment and apparatuses. This basically revealed the standard of our country's environmental protection industry. At the conference, we organized 13 special topic lectures on environmental protection technology and launched technological consulting services, which were welcomed by all people, especially the factory technological personnel. There were 80,000 spectators from all over the country. This successful attempt has opened up the channel between production and necessity and promoted the development of the environmental protection industry.

In addition, our society has popularized knowledge on the environmental sciences through diverse forms such as displays in art galleries and slide shows on popularizing science as well as summer camps. We have also paid attention to bringing into play the role of films and television in propaganda.

4) We have vigorously launched and promoted environmental education.

Education is the strategic focus for realizing modernization. The development of mental resources is the important guarantee for developing the cause of environmental protection. Our society has initiated some work in promoting education which has enhanced the establishment of our environmental education system.

At the first conference on environmental education in 1979, we put forth a proposition that we should launch an all-people and full-course environmental education throughout the country. Under the leadership and support of the education departments and environmental protection departments, and through the effort over the last few years, our country has laid down the preliminary framework for launching environmental education in kindergartens, elementary schools, secondary schools and colleges as well as among in-service cadres. The society has also organized the work of compiling teaching materials and providing teaching staff. It has also taken part in pilot projects and urged several institutions of higher learning on to trial-run an environmental protection profession. In Lanzhou, a pilot project has been launched on environmental education in kindergartens, and international exchange in environmental education has been conducted. The societies in Beijing, Tianjin, Guangdong and Fuijian have launched pilot projects in environmental education in secondary and elementary schools, and definite experiences have been scored.

In September 1979, for the first time, our society held the first term of cadres training classes in environmental protection in Dalian. In-service cadres underwent professional and technological training. In the following 4 years, we have assisted the environmental control departments to hold eight terms of in-service cadres training classes and three terms of in-service technological training classes, whereby over 1,400 cadres have been trained by rotation.

5) We have edited and published a number of books and journals on environmental protection.

In the last 5 years, the society and the various branch societies and professional committees have published 20 collections of theses and 7 environmental periodicals. The Science Publishing House has compiled and printed over 20 books on popularizing the science of environmental protection for laymen. A total of over 500,000 copies have been sold. These publications have played a definite role in the exchange of the results of scientific research and in the popularization of the knowledge in the environmental sciences.

Oranized by the China Encyclopedia Publishing House, our society has taken part in organzing scientific workers to compile the "Environmental Sciences--A Chinese Encyclopedia," which has now been published. This is of important significance to promoting the development of environmental science and technology and the cause of environmental protection. Our society has also compiled teaching materials in environmental education. At present, we have published "An Introduction to the Environmental Sciences" and "An Introduction to Environmental Protection," and are compiling "A Central Survey on Environmental Protection" and "Environmental Control for Industrial Enterprises." Under the sponsorship of our society and co-sponsorship of concerned sectors, we have put out the following five periodicals--"China's Environmental Sciences," "Environmental Engineering," "Environmental Chemistry," "Environmental Control" and "Environment," as well as the following two journals--"Noise and Vibration Control" and "Environmental Consultation" for internal distribution on a trial basis. In addition to the journals sponsored by societies everywhere, we have put out a total of over 30 journals, the quality of which is continuously improving and the number of copies sold gradually increasing.

6) We have preliminarily launched the work of scientific and technological consulting services involving environmental protection.

Technological consulting service is a new type of work. Our society has primarily begun work in two aspects. One is to launch consulting service locally through conferences. Another is to carry out consulting on environmental impact assessment and on the technology of pollution treatment of the construction projects. The Environmental Engineering Society integrated its academic activities with the assessment of the comprehensive treatment of the Yundang Harbor in Xiamen, the environmental planning of Jinan City, the processing and technological process of waste water treatment of the Dingjiashan Coppermine in Jiujiang. The society has also organized scientific and technological personnel to carry out technological contracting in order to solve actual problems of some factories in the production of environmental protection equipment. All these are welcomed by the concerned sectors and factories. By the end of 1982, our society has set up consulting service centers, which have successively offered consulting services to the Beianhe Machinery Plant, the Shenyang Metal Network Plant and the Dalinxing Placer Plant and have helped these enterprises solve problems in environmental pollution treatment. These centers have also launched the work of assessing environmental effects of the Beijing Paint Factory, the Beijing No 5 Pharmaceutical Plant, the Beijing Cement Factory, and the Pingdingshan Cord Fabric Plant. Recently, under the unified organizational leadership of the China Scientific and Technical Association, we have participated in the assessment of the environmental impact on the feasibility study of the Zhungeer Coalmine.

7) We have gradually perfected the organizational structure of the society and preliminarily set up a working system for the environmental sciences societies throughout the country.

After the first congress convened by the society, we have successively set up two branch societies in the control, economics and law of the environment and in environmental engineering. We have set up 11 professional committees on environmental theories, ambient quality assessment, environmental analysis and monitoring, environmental geochemistry, the geography of pollution, environmental biology, environmental chemistry, environmental acoustics, marine environment, environmental medicine, environmental standards and atmospheric environmental sciences. We have also set up five committees in academic work, scientific popularization, education, editing and consulting. With the exception of Xizang, environmental societies have been founded in the 28 provinces, municipalities and autonomous regions throughout the country and equipped with full-time and part-time cadres. Societies have also been set up in many municipalities under provincial jurisdiction and prefectures under municipal jurisdiction. The broad masses of environmental scientific and technological workers have actively joined their respective organizations. Statistics show that there are over 20,000 members throughout the country. The metallurgical, light industrial, weapons, agricultural, maritime, water conservancy and nuclear industrial departments have also successively set up environmental societies or professional committees: In line with their own characteristics, they have launched academic activities which in turn have enhanced the development of environmental science and technology of their respective departments and undertakings.

In short, in the last 5 years since the founding of our society, we have made definite contributions to opening up a new realm of environmental sciences in our country, promoted environmental scientific research and developed the cause of environmental protection.

Basic Experience

Our society is a new one. We lack work experience. In addition, environmental science is a new and intensely comprehensive science that involves almost all branches of learning. Thus, we also lack experience in launching activities of the society. In the last 5 years, our society has relied on the enthusiasm of the broad masses of members in getting much work done and in preliminarily coming up with some work experiences, which can be summarized in the following three basic experiences:

1) The foothold of the society's work is to launch academic activities that revolve around major environmental issues in China.

The goal of scientific and technological development, which is also the orientation of the society's work, is to serve economic construction and realize the four modernizations. In the early days since the founding of our society, our academic activities were not sufficiently linked up with our reality. Often, individuals would present their theses or research reports without enthusiastic participation in discussion. In the last 2 years, we paid attention to linking academic activities with realistic issues. Centering on the major environmental issues in our country, we

launched academic activities on many occasions in such aspects as the strategic thinking in environmental protection, the principles and methods of environmental control, the policies in environmental protection technology, and the technology of pollution prevention and treatment. Through these academic activities, we pooled the wisdom of the broad masses of scientific and technological personnel, and conscientiously summed up practical experiences, including successes and failures. Then, we summarized our theories and found out the laws, and made directional proposals to solve practical issues. In this way, not only have we enabled academic activities to serve economic construction, but we have also invigorated academic thinking, promoted scientific research and enhanced the development of environmental sciences.

What is the strategic thinking of China's environmental protection? There are many different levels of understanding. Our country is a developing country with a backward economy. While we must not follow the former example of the industrially developed nations of the west in sacrificing the environment in order to develop the economy, we must also not follow their present example. Through academic discussions, most of the comrades feel that, in line with our country's reality, the strategic thinking of our country's environmental protection should be: First, we must establish the thinking of improving the environment while developing the economy and promoting economic development while improving the environment. Second, we must establish the thinking of serving the four modernizations. Although there is a conflicting side between environmental protection and economic development, there is also a side of mutual promotion. Environmental protection not only will play the role of curbing the economy, but more importantly will play a promoting role. Environmental protection must render service to developing the economy and raising the socioeconomic results. Clarifying these two strategic ideas is of important realistic significance to the development of the cause of environmental protection and to the goal of research in environmental sciences.

The standard of industrial production in our country is low. However, the discharge of pollutants is one of the highest in the world. A large quantity of facts proves that the most important reason is improper management, which allows a large quantity of resources which can be utilized to become wastes that pollute the environment. In light of this reality, the environmental control academic forum, held in 1980, proposed that we "put environmental control in the foremost position in the work of environmental protection." Through strengthening control, we can reduce the discharge of pollutants to to the greatest extent. At the enterprise environmental control academic forum, we further proposed the contents, tasks and goals of environmental control. Enterprise environmental control must be linked with the entire process of enterprise management and permeate the various aspects of professional control, including production control, planning control, technological control and equipment control. It must also be integrated with integrated with the various economic systems of responsibility of the

enterprise. We have popularized the experiences in scientific environmental control of such enterprises as the Changling Oil Refinery, the Shenyang Smelting Plant and the Capital Iron and Steel Company, thereby enabling our work of environmental control to shift from treatment of the three wastes to the implementation of all-round environmental control. At the same time, these experiences have also promoted research on the science of environmental control in our country, and enabled the environmental sciences to move primarily from natural science research into several disciplines in the social sciences. The study of environmental control, environmental economy and environmental law have also developed in our country.

In academic discussions on many occasions, we have summed up our country's experiences over the years in the technological treatment of air and water pollution. We have clearly proposed technological policies on air and water pollution. In the past, we were primarily involved in transforming furnaces. Although this could economize fuel, its results in the change of air quality were not obvious. Some comrades proposed that we must change the fuel components and carry out central heat and gas supply. However, due to the limited economic strength in our country, we were only able to carry out central heat and gas supply in certain places where the conditions exist, replacing the scattered furnaces and small stoves of thousands and tens of thousands of households. In most areas and cities, we should primarily carry out small-area and select-area heating, make full use of the surplus heat from the factories, and actively develop smokeless and low-sulphur solid fuel. As for pollution of the water body, countries abroad have popularly adopted the construction of sewage treatment plants, some of which have implemented secondary and tertiary management. Both investment and operational expenses are very high. At the present stage, our country cannot build sewage treatment plants on a general basis. We should regard water as a valuable resource, encourage practicing economy in the use of water, circulating the use of water and recycling sewage, and actively develop the system of soil treatment and sewage purification. Most of these major technological policies involving environmental protection have been adopted by the concerned departments. At the same time, they have enhanced the development of our country's science and technology.

Practice has proven that launching academic activities in integration with our country's major environmental issues is the basic orientation of our society in serving economic construction and serving the society and is an important approach to enhancing the development of our country's science and technology. Also, only in so doing can we truly bring the role of the society as counselor and consultant into play.

2) An important duty of society is to bring into full play the superiority of the society in going beyond the boundaries of disciplines and sectors, in establishing horizontal ties and in assembling skilled personnel to make suggestions and proposals to the state in the latter's decision making.

Our country's environmental scientific research began rather late and our technology is relatively backward: In addition, the environmental issue is an extremely complex one, with obvious regional and comprehensive characters and latent risks. Although the industrially developed nations have accumulated some technological experiences in pollution treatment, there is not one entirely successful approach from which we could borrow. Thus, in organizing academic activities, our society has on the one hand paid attention to closely integrating our country's major environmental issues, and on the other hand paid attention to bringing the society's superiority into play, mobilizing the enthusiasm and creativity of the scientific and technological personnel, integrating with reality, giving prominence to academic democracy, pooling the wisdom of the masses, conscientiously summing up the experiences both at home and abroad, actively making proposals and suggestions for the administrative departments in the latter's decision making, and enabling the society to truly play the role of the brain trust.

There are generally three approaches to giving play to the role of the society as the brain trust. The first one is to organize academic forums to organize discussions and research in a planned manner on longstanding controversies or policy decisions which the administrative departments have found difficult to make. The second one is to organize experts in all areas to carry out investigations and inspections, and make proposals on treatment in certain environmental pollution issues. The third one is to organize experts to assist localities in formulating environmental protection plans or take part in technological consulting.

The formulation of environmental standards is a highly technical work that is tantamount to policy. For a longer period of time, in academic circles and in practical work, there have been contentions as to the principles, systems and methods of formulating our country's environmental standards. At the academic discussion on environmental standards, the scientific and technological personnel from such sectors as medicine, agriculture, water conservancy, industry and environmental protection have proceeded from the research in the various disciplines and expressed different viewpoints accordingly. Since the society is not restricted by the administrative departments, all the participants have been able to speak out freely, air their own views and carry out debate with enthusiasm. Through discussions by the experts, we have preliminarily unified our understanding of this subject of longstanding and endless debate. Finally, we have proposed a draft of the regulations on management of environmental standards for the state. This draft has already been adopted by the administrative departments. This has played a positive role in promoting the work and the scientific research involving environmental standards.

Sewage irrigation has enjoyed a relatively long history in our country. Since sewage irrigation has brought about the issue of environmental pollution, a heated dispute has been carried out on the gains and losses and advantages and disadvantages of sewage irrigation. The administrative departments have found it difficult to make policy decisions accordingly.

In conjunction with the China Agronomy Society, our society convened a dis-discussion on "sewage irrigation and the environment." We invited experts and scientific and technological personnel from all fields to conscientiously sum up, with a scientific attitude, the pilot experiences in sewage irrigation and analyze data rigorously. Through discussion, most of us felt that sewage irrigation was necessary and that it was a measure of long-term strategic significance involving comprehensive utilization and conversion of the harmful to the useful. The pollution issue resulted from sewage irrigation was primarily brought about by irrational irrigation. Thus, what we should solve properly was the problem of scientific irrigation. All the participants suggested that, before being used for irrigation, sewage must undergo definite treatment until it met the standards of farmland irrigation. Cleaning sewage and irrigation by rotation were proposed. If we manage sewage irrigation properly, we not only can economize sewage treatment expenses and reduce the pollution of the water body, but can also provide water resources and fertilizer for agriculture, which will enhance the development of agricultural production. Through discussion by the experts and scientific analysis on sewage irrigation, we have at the same time put forth urgent research topics to provide the scientific bases for a rational sewage irrigation.

Jinan City has formulated an urban environmental protection plan. Upon the invitation of the Jinan Municipal People's Government, our society has organized experts from such fields as geology, water conservancy, municipal government, industry and environmental protection to take part in the assessment of the environmental protection plan of Jinan. Through on-the-spot visits, the various experts have, from different angles, put forth propositions regarding the urban character of Jinan City, the direction of attack in environmental protection work, the relationship between economic development and environmental protection, the way to broaden sources of income and reduce expenditure, the recovery of the spring city, the comprehensive treatment of air pollution, the comprehensive treatment of urban sewage, and the improvement of the landscape of the spring city.

Shandong Province and Jinan City have attached great importance to these propositions, and instructed the concerned departments to research and implement the plans for revision and supplementation.

All these have shown that, in uniting with the broad masses of scientific and technological personnel, the society has become a treasury of skilled personnel and knowledge across sectors, and is able to play the role of brain trust for the state in the latter's decision-making.

3) A strategic task of the society is to popularize and raise the knowledge of the environmental sciences and the scientific and technological standards of the whole nation.

Environmental science is a new and highly comprehensive science. Environmental protection is also a new work in our country. To transform the environment and develop the economy, mankind must understand the structure and function of its earth environment and its law of evolution, and understand

the environmental quality needed to protect the natural resources and sustain human beings and living things. Presently, environmental pollution and damage in our country have not been checked. In certain areas, they have continued to develop. A basic reason is the lack of knowledge in the environmental sciences of many people, including leading cadres and technological personnel. These people do not understand that economic and social development must accord with the ecological laws of nature, and do not understand the structure and function of the earth's environment. In economic and social activities, they care only about the immediate and partial interests, and ignore the longstanding latent impact on society. If this situation does not change, it will be difficult to promote the cause of environmental protection. After the founding of our society, we have regarded environmental education and the popularization of environmental knowledge as important tasks, and have adopted many forms and channels in launching this work.

a) We have carried out widespread propaganda on the knowledge of the environmental sciences in society. In 1980 and 1981, we have launched two large-scale environmental propaganda months, during which we organized and mobilized large numbers of personnel from the scientific, literary and art and news circles to propagate the basic knowledge in the environmental sciences, the harm of environmental pollution as well as some models in proper pollution treatment. We have aroused the attention of leading cadres at various levels toward the work of environmental protection and raised the understanding of the broad masses in environmental protection. In the activities during the propaganda months, leading cadres of many districts personally took an interest in the work of environmental protection and handled the environmental issues which needed to be solved urgently. In addition, many people have acquired preliminary understanding of such phrases as environmental protection, ecological balance and ecological laws.

b) We have enhanced the launching of environmental education in schools. In order to nurture a new generation and enable this generation to establish the thinking of environmental protection from childhood, our society has assisted administrative departments in launching full-course environmental education in school education. The education commission has played a pioneer role in this regard. At present, many universities have set up the environmental profession and have taken "A Survey on Environmental Protection," compiled by the education commission, as college teaching material. Environmental protection is also included in secondary and elementary school textbooks. Individual kindergartens have also carried out pilot projects in environmental education and compiled teaching materials on environmental education for young children.

c) We have launched the work of popularizing pollution treatment technology. In 1982, the society held in Shanghai an exhibition on environmental protection equipment. This was a good form of popularizing the applied technology in pollution treatment among medium-sized and small enterprises. The society not only should organize academic exchanges, but should orient its work toward the basic level, severe production and popularize applied technology.

d) An important content in the all-people environmental education is to launch professional training among in-service cadres. For many cadres and technological personnel, environmental protection is a new work. Here, we are not only faced with the problem of the ageing of knowledge, but with the problem of gaps in knowledge and the necessity to make up for this knowledge. In the last few years, with the support of the administrative departments, we have held training classes and research classes for in-service cadres in environmental protection (including leading cadres and technological personnel in environmental protection of the provinces, municipalities and enterprises), and have raised to varying degrees the scientific and technological level and professional standards of these in-service cadres and teachers.

The above experiences have shown that a strategic task for the society in developing mental resources is to adopt a variety of forms and channels to propagate and popularize the knowledge in the environmental sciences and launch environmental education in a widespread manner.

9335
CSO: 4008/209

PHOTOCHEMICAL OXIDANTS IN AIR QUALITY DISCUSSED

Beijing ZHONGGUO HUANJING KEXUE [ENVIRONMENTAL SCIENCES IN CHINA] in Chinese No 1, 21 Feb 84 pp 68-72, 67

[Article by Tang Xiaoyan [0781 1321 3508], Li Jinlong [2621 6855 7893], Li Wen [2621 2429] and Chen Danhua [7115 2481 5478] of the Department of Technology and Physics, Beijing University; Wang Wenxing [3769 2429 5281], Weng Jianhua [5040 1696 5478] and Tang Dagang [3282 1129 4854] of the China Environmental Sciences Research Institute; and Zhou Guiling [0719 2710 3781] of the Environmental Protection Bureau of the Ministry of Urban and Rural Construction and Environmental Protection: "Photochemical Oxidants in Air Quality Standards"]

[Excerpts] Photochemical oxidants are primary pollutants released into the air. Nitrogen oxide and hydrocarbon are produced through a series of reaction under solar action. They primarily include ozone, carbon dioxide and peroxyacetyl nitrate (PAN), which can release oxides of iodine molecules from potassium iodide solution. Of these, ozone (O_3) is the representative, which generally constitutes more than 90 percent of the density of the oxidants. According to the principles stipulated by the state on air quality standards, in formulating the standards for photochemical oxidants, we must master the following relevant materials: Natural and man-made sources, the conditions and mechanisms for occurrence, physical and chemical attributes, temporal and spatial factors for their distribution in the air, the environmental impact, as well as the feasibility of the environmental standards and the probability of goal attainment. All these are the bases for the formulation of standards.

In order to coordinate the work of formulating the standards of photochemical oxidants for our air quality standards, we have launched investigation and study on materials involving the various above-mentioned aspects. In addition, in light of the lack of measured data on photochemical oxidants at home, we have conducted on-the-spot monitoring of ozone density in the air in some areas at home, namely the urban areas, the suburban areas, the industrial areas and the sanitary areas. We have carried out study and comparison on the methods of monitoring and analyzing photochemical oxidants. In addition, we have consulted relevant materials from abroad in line with the extent of harm of ozone on man's physical health, on vegetation and on materials. On this basis, we have put forth a proposal involving the

three-level criteria for photochemical oxidants in our air quality standards.

I. The Measured Situation of Ozone Density in the Air over Certain Areas of China

A. In 1980, we carried out an on-the-spot monitoring of ozone density in the air in Lanzhou, Shanghai and Beijing. In the summer of 1981, we again carried out on-the-spot monitoring at several representative areas (scenic areas, urban areas, industrial areas and so forth). These areas were as follows: The urban areas of several large and medium-sized cities such as Beijing, Shanghai, Shenyang, Fushun, Qingdao, and Lanzhou; the seaside resort of Qingdao City and the Laoshan scenic area; and the Yanshan Petrochemical Area in Beijing and the Jinshan Petrochemical Area in Shanghai.

The apparatuses used were the 560 portable ozone analyzer (ethylene chemiluminescence method) produced by the AID Company of the United States and the PW9700 ozone monitor (the Luo Dan Ming [5012 0030 2494] B chemiluminescence method) produced by Phillips of Holland. These apparatuses made use of the method of boric potassium iodide for standardization.

The results of the monitoring were seen in Table 1 and Diagrams 1 to 4. Table 1 shows the results of actual monitoring of ozone industry (frequency distribution statistics expressed in terms of average value per hour) in various localities. Diagram 1 shows the frequency distribution based on the summary of data in Table 1. Diagrams 2, 3 and 4 separately present the curves showing the daily changes of typical ozone density in fine and foul weather of the sanitary control areas and the urban areas.

B. From 21 July to 3 September 1979, the Gansu Provincial Environmental Protection Institute carried out a 28-day monitoring[1] of the density of photochemical oxidants in the air in Xigu Area (a petrochemical area) in Lanzhou City. The chemical method adopted involved alkaline potassium iodide. During this period, there were 10 days with the largest average value per hour that was less than 0.04 ppm and 5 days with the value from 0.04 to 0.06 ppm. There were 4 days with values from 0.06 to 0.08 ppm and 4 days with values from 0.08 to 0.10 ppm. There were 5 days with a value over 0.10 ppm, with the largest average value per hour being 0.122 ppm.

The Environmental Protection Institute of the Lanzhou Chemical Industrial Company adopted the method of using neutral or buffered potassium iodide. The results of the monitoring[2] showed: In 1978, the average value per hour of photochemical oxidants greater than 0.08 ppm occurred 26 times over 13

1. Gansu Environmental Protection Institute, Environmental Sciences, 1 (5), 24 (1980).

2. Environmental Protection Institute of the Lanzhou Chemical Industrial Company, Lanzhou Science and Technology, 4, 14 (1980).

days, with the highest value being 0.21 ppm. In 1979, the average value per hour of photochemical oxidants greater than 0.08 ppm occurred 35 times in 13 days, with the highest value being 0.26 ppm.

C. From 27 July to 4 August 1981, the China Environmental Sciences Research Institute and the Gansu Provincial Environmental Protection Bureau organized a comprehensive monitoring of ozone density in the air in Xigu Prefecture. The method of using boric potassium iodide for analysis was adopted. Simultaneous monitoring was carried out on 12 testing points. The results showed that the Xigu Prefecture itself (which was the source of pollution) had a density of photochemical oxidants which sometimes went up as high as 0.10 to 0.20 ppm. In addition, in the downwind areas (the farthest testing point, roughly some 40 km from the source of pollution), high density was monitored at an average value per hour greater than 0.10 ppm on 10 occasions, with the highest value at 0.3 to 0.4 ppm.

From the existing incomplete materials in our country, we can recognize the following characteristics:

From the results of our monitoring, regardless of region, roughly over 95 percent had an average value per hour smaller than 0.06 ppm.

The average value per hour of ozone in the sanitary control areas was generally smaller than 0.06 ppm. Furthermore, the daily changes in ozone density of this category of areas were generally small in scale. That is to say, peak values appeared slowly and insignificantly. Inversely, in the urban areas and the downwind areas from the source of pollution, the daily changes in ozone density were extremely significant and the peak values were precipitous and prominent. The daily change in ozone density is a characteristic that is closely linked to the source of ozone of a particular area.

Generally speaking, the peak values of urban areas and industrial areas are higher. For instance, after monitoring over a 65-day period from April to August 1981, it was determined that, in the urban areas in Beijing, there were 3 days with an average value per hour greater than 0.10 ppm, with the highest value being 0.105 ppm. In some urban areas and industrial areas, very complicated pollutants both in kind and in quantity were released and changes in meterological factors were greater. Thus, a situation similar to that detected in Xigu Prefecture in Lanzhou in the summer of 1981 might occur, i.e., while ozone density in the source of pollution was not high, ozone density in the downwind suburban and rural areas was higher.

In recent years, we have already ascertained the existence of photochemical smog pollution in the air of the Xigu Prefecture in Lanzhou, and that in the months of July, August and September every year, the average value per hour of ozone density has on many occasions gone above 0.10 ppm.

II. The Harm of Ozone and Environmental Standards

A. Damage to Human Health

The primary and direct harm to human health takes place in the respiratory system. Sometimes, it will also indirectly lead to such general symptoms as headaches and depression. The olfactory threshold value of ozone is 0.008 to 0.20 ppm for the most sensitive individuals, and the threshold value for eye irritation is 0.1 ppm.

On 24 August and 6 September, in the days when Lanzhou was affected by photochemical smog pollution, an investigation[3] was conducted on 2,561 people of 16 units in respect to conscious symptoms. The results indicated that: 76.5 percent of the people suffered from eye irritations (primarily dryness, tearing and photophobia); 49 percent felt dizzy; 37 percent experienced headaches; 35 percent developed coughing, depression and difficulty in breathing; 25.4 percent experienced nausea; 22.5 percent experienced dried and sore throat; and 18.6 percent experienced nasal congestion and drainage. In 1979, based on long-term study results, the special topic group of the WHO on environmental health standards held that an hourly density of 0.05-0.01 ppm (determined by chemiluminescence) can be the guiding criterion for protecting public health.[4]

III. Standard Method of Analysis

Presently, our country has few chemiluminescent monitoring apparatuses which are expensive. In the near future, we can only use the chemical method involving potassium iodide as our standard method of analysis. This means that the standard value is the gross amount of the photochemical oxidants.

As reported in literature[5,6,7,8], there are three methods that adopt potassium iodide: The method involving neutral potassium iodide (NBKI), the method

---

3. Gansu Provincial Environmental Protection Bureau, 1980 trial version of the report on the environmental quality of the urban areas in Lanzhou City, Gansu Province, 1981.

4. WHO, Photochemical Oxidants (Environmental Health Criterion No 1), 1979, translated version by the Foreign Affairs Office of the State Environmental Commission, 1982.

5. U.S. EPA, EPA-600/8-78-004, 1978.

6. Flamm, D.L., Environ Sci Technol 11 (10), 978-83, (1977).

7. Tokiwa, Y., EPA-650/4-75-016 (1975).

8. U.S. EPA, Air Quality Criteria for Ozone and Other Photochemical Oxidants, 116 (1978).

involving alkaline potassium iodide (AKI), and the method involving boric potassium iodide (BKI). Compared to the ultraviolent absorption method, the determined results of the three methods are as follows: The determined results using the NBKI method is 10 to 20 percent higher. The AKI method is 54 percent lower than the NBKI method. The determined results of the BKI method is basically the same as the UV method (with 2 percent margin of precision).[9]

We have made use of the three chemical methods to carry out research on the experimental conditions in the standardization of the chemiluminescent apparatuses.[9] The results of the experiment shows that: The AKI method has poor responsibility and low sensitivity. The NBKI method has demanding experimental conditions with high variability. Under non-automatic conditions, it is not easy to obtain stable data. The BKI method does not have the above-mentioned shortcomings and has good stability and repeatability. The method is simple, and is quite suitable to be used as a monitoring method under non-automatic continuous conditions.[10]

IV. The Present Situation of the Standards of Photochemical Oxidants

D. The standards of photochemical oxidants in China.

Air quality standards should take the environmental standards as the basis and should be formulated in respect to the social, political, technological and economic aspects and in an economically rational manner. However, at present, we still have not had sufficient relevant materials which are suitable for our country's situation. Thus, for the time being, we can only formulate standards based on the existing materials at home, and by using materials from broad as reference in an appropriate manner. According to the materials and data from various aspects that are put forth in this article, and according to the principle of classification for our country's standards, the Environmental Protection Leading Group of the State Council has, on 6 April 1982, formally issued the air quality standards for our country.

In the regions at various levels, the average value per hour of photochemical oxidants (using the chemical method involving the buffering of potassium iodide by boric acid) must not exceed the following corresponding criteria for more than once a month:

Primary criterion:	0.06 ppm, which is 0.120 mg/cubic meter
Secondary criterion:	0.080 ppm, which is 0.160 mg/cubic meter
Tertiary criterion:	0.100 ppm, which is 0.200 mg/ cubic meter.

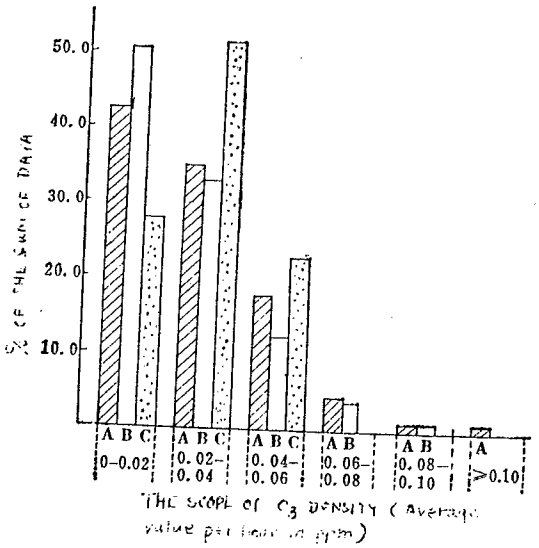
9. Chen Danhua, et al, China Environmental Sciences, 3 (5), 50-55 (1983).

10. Qi Liwen (7871 4539 2429), et al, Environmental Sciences News, 5, 42 (1983).

Table 1 Measured Results of Ozone Density in the Air from 1980 to 1981 (Average Hourly Statistics)

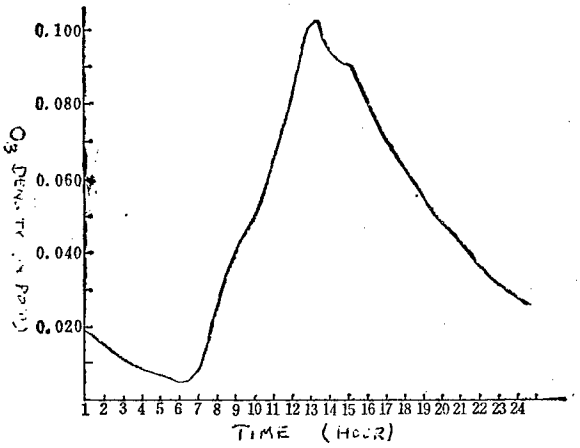
Monitored Location		Monitered Date	Sum of Data	Frequency distribution (No. of individuals) of the average value per hour according to the scope of density (in ppm)																						Average value (ppm)
				0~0.01		0.02~0.03		0.04~0.05		0.06~0.07		0.08~0.09		0.10~0.11		0.12~0.13		0.14~0.15		0.16~0.17		0.18~0.19		≥0.20		
			individual	individual	%	individual	%	individual	%	individual	%	individual	%	individual	%	individual	%	individual	%	individual	%	individual	%	individual	%	individual	%	
Urban Area	Zhongguancun Area in Beijing Municipality	2/4~17/4	265	66	24.9	54	20.4	61	23.0	51	19.2	23	8.7	8	3.0	2	0.8										0.066
		16/5~25/5	212	58	27.4	45	21.2	29	13.7	35	16.5	24	11.3	13	6.1	3	1.4	2	0.9	2	0.9			1	0.5	0.100
		15/6~1/7	333	52	15.6	41	12.3	76	22.8	49	14.7	45	13.5	37	11.1	17	5.1	6	1.8	6	1.8	2	0.6	2	0.6	0.105
		27/7~18/8	532	125	23.5	123	23.1	103	19.4	63	11.8	48	9.0	35	6.6	25	4.7	5	0.9	4	0.8	1	0.2			0.091
		Total	1342	301	22.4	263	19.6	269	20.0	198	14.8	140	10.4	93	6.9	47	3.5	13	1.0	12	0.9	3	0.2	3	0.2	
	Shanghai Municipality	5/8~8/8	69	11	15.9	21	30.4	9	13.0	13	18.8	8	11.6	2	2.9	1	1.4	2	2.9	1	1.4			1	1.4	0.100
	Shenyang & Fushun	15/7~21/7	97	21	21.6	34	35.0	28	28.9	8	8.2	3	3.1	3	3.1											0.046
	Qingdao	6/7~7/7	29	12	41.4	5	17.2	6	20.7	2	6.9	2	6.9	1	3.4	1	3.4									0.062
	Lanzhou	6/7~11/6	63			7	11.1	13	20.6	12	19.0	10	15.9	12	19.0	5	7.9	4	6.3							0.079
		Total	1600	345	21.6	330	20.6	325	20.3	233	14.6	163	10.2	111	6.9	54	3.3	19	1.2	13	0.8	3	0.2	4	0.3	
Sanitary Area	Seaside resort of Qingdao Laoshan scenic area	2/7~5/7	85	1	1.2	22	25.9	19	22.4	24	28.2	13	15.3	6	7.0											0.057
Petrochemical area	Beijing Yanshan Petrochemical area	18/8~22/8	77	23	29.9	7	9.1	13	16.9	4	5.2	11	14.3	8	10.4	3	3.9	4	5.2	2	2.6	2	2.6			0.097
	Shanghai Jinshan Petrochemical area	29/7~3/8	123	6	4.9	65	52.8	24	19.5	22	17.9	5	4.1	1	0.8											0.055
	Total		200	29	14.5	72	36.0	37	18.5	26	13.0	16	8.0	9	4.5	3	1.5	4	2.0	2	1.0	2	1.0			

Diagram 1 Diagram Showing the Frequency Distribution of the Measured Results of Ozone Density in the Air



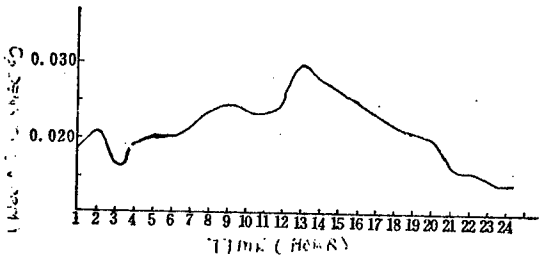
A. Monitored results of the urban area; sum of data: 1,600 individual cases.
B. Monitored results of the petrochemical area; sum of data: 200 cases.
C. Monitored results of the scenic area; sum of data: 85 cases.

Diagram 2 Ozone Density in the Air Outside the Beijing University Technology and Physics Building in Zhongguancun in Beijing Municipality



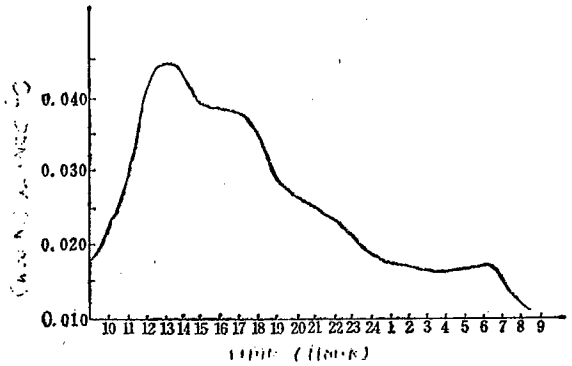
Time: 19 June 1981
Weather: Sunny with intermittent cloudiness, wind changing from south to north. Force 2 and 3 wind changing to force 1 and 2 wind. Highest temperature 28 C, lowest temperature 20 C.

Diagram 3 Ozone Density in the Air Outside the Beijing University Technology and Physics Building in Zhongguancun in Beijing Municipality



Time: 6 August 1981
Weather: Cloudy with rain, force 2 and 3 wind from the south changing to force 1 and 2 wind. Highest temperature 26 C, lowest temperature 19 C.

Diagram 4 Ozone Density in the Air at the Beijiushui Sanatorium at Laoshan in Qingdao City



Time: 4 July 1981
Weather: Clear with intermittent cloudiness, force 2 and 3 wind. Rain at night.

9335
CSO: 4008/209

ENVIRONMENTAL IMPACT OF KAIDU HE WATER CONSERVANCY PROJECTS

Beijing ZHONGGUO HUANJING KEXUE [ENVIRONMENTAL SCIENCES IN CHINA] in Chinese No 1, 21 Feb 84 pp 64-67

[Article by Wang Shiying [3769 0013 5391] of the Xinjiang Uygur Autonomous Region Environmental Protection Bureau: "The Environmental Impact of the Water Conservancy Projects of the Kaidu He Basin"[1,2]

[Text] The Kaidu He is the river in the southern slope of the Tian Shan that has the most abundant supply of water. It originates in the Saaerming Shan and empties into the Bositeng Hu (referred to as the Bo Hu below) in the Yanqi Basin. The entire length of the river is 661 km, with an annual average runoff of 3,362,000,000 cubic meters. The water flowing out of the Bo Hu is known as the Kongque He. In terms of water resource, the Kaidu He and the Kongque He make up the upper and lower reaches of the same river, while the Bo Hu plays the role of the connecting link between the two. Thus, the rational development and utilization of the water resources of the Kaidu He are of paramount importance to the development of agriculture, forestry, animal husbandry, sideline occupation, fishery and industry, as well as the ecological environment and ecological balance of the Yanqi Basin and the Kuerle and Weili prefectures. We have carried out special-topic investigations on the water conservancy projects of the Kaidu He Basin as well as the impact of these projects on the ecological environment. The following is a summary of our findings for discussion.

I. Survey of the Water Conservancy Projects of the Kaidu He Basin

Since liberation, we have vigorously developed and utilized the water resources of the Kaidu He and have built some water conservancy and irrigation projects. On both banks of the lower reach of the Kaidu He alone, we have built 17 permanent main diversion canals and 20 trunk diversion canals, with a total length of over 320 km, a conveyance and diversion capacity of 172.5 cubic meters/second, and an annual diversion capacity of 1,872,000,000 cubic meters. The main canals control nearly 2 million mu of land and irrigate 1.07 million mu of farmland inside the Yanqi Basin. The construction of these water conservancy projects has played a major role in promoting the development of agricultural production in the basin.

However, for a long period of time, due to the lack of an ecological viewpoint and a viewpoint of unified planning with due consideration for all concerned as well as an overall comprehensive balance, we paid attention only to the use of water in grain production and neglected the protection and utilization of the Bo Hu and its precious natural resources. In our policy concerning water conservancy, we "emphasized construction and slighted management," "emphasized irrigation and slighted drainage," and "emphasized projects and slighted complementary facilities." As a result, the superiority of the abundant water resources of the basin was reduced to an inferiority.

II. Inappropriate Water Conservancy Projects of the Kaidu He Basin and their Impact on the Ecological Environment

Some inappropriate water conservancy projects of the Kaidu He Basin have brought about sreious water conservancy and environmental problems.

A. The groundwater level rose on a general scale, and secondary salinization of the soil and growth of marsh became serious.

The repairs and construction of large number of drainage and conveyance projects have changed the former hydrological regional conditions and greatly raised the groundwater level of the two sides of the main canals. In the case of the Jiefang No 1 Canal, for example, we originally planned to drain 7 cubic meters/second of water. Due to the expansion of the acreage of farmland of the Kongque He Irrigation Zone and the demand of the use of water to generate the Tiemenguan Power Station, we increased the drainage volume year after year to 40 cubic meters/second. We changed the water conveyance time from a seasonal one to an all-year-round schedule. The annual drainage volume totaled 515 million cubic meters. Because of serious leakage of the canals, the groundwater level along the two sides of the canals were greatly raised (see Table 1). Generally, the groundwater level along the two sides of the canals within the 11-meter perimeter was 0.26 meters, while that within the 200-meter perimeter was generally under 0.80 meters.

The soil was highly saline and secondary salinization occurred throughout. In particular, in the lower section of the Jiefang No 1 Canal, the level of the canal was almost or even higher than the paralled contour of the land surface. This blocked the flow of surface water and groundwater to the low-lying lake region, and formed a ponded region where water failed to be drained. Large-area secondary salinization occurred in the soil. The Chengzi Commune 40 li away from Yanqi County was seriously affected by the Jiefang No 1 Canal. Prior to 1976, 1,600 mu of farmland was abandoned due to secondary salinization in the soil and growth of swamp. In 1980, 6,400 mu was affected. Due to the harm brought about by salinization and the growth of swamp, the per-mu output was only around 100 jin. Many houses collapsed. The farm of the 27th Regiment, affected by the Jiefang No 1 Canal, also abandoned 1,700 mu of farmland, thereby reducing output by 50 percent.

Table 1 Impact of the Jiefang No 1 Canal on the Groundwater Table of the Surrounding Area

Distance from the Canal (m)	11	47	95	145	195
Groundwater table (m)	0:26	0:46	0:64	0:66	0:79

In constructing the Kaidu He Drainage and Irrigation Project, due to the lack of unified planning with due consideration for all concerned and unified planning and management, we drained water randomly and imposed no restrictions on the use of water. Chaos resulted in the Kaidu He Irrigation Zone, with a crisscross network of canals and sluice gates. In particular, during the period of water shortage in the spring, the various units all strove to be the first to build temporary dams on the Kaidu He for the drainage of water. This resulted in the bank-up of river bed deposits and in the formation of washlands which lowered the flood discharge capability of the river bed. For instance, in 1969, the water level of the Yanqi Bridge after the 630 cubic meters/second flow reached the water level after the 854 cubic meters/second flow in 1958. The groundwater level was also raised through utilizing old canals, which were tortuous, for drainage, and through juxtaposing several canals, which increased the water loss in conveyance.

Most of the irrigation canals were simple and crude, without leakage-prevention facilities. Losses sustained from leakage were serious. At present, the output coefficient of the canals in the basin is generally around 75.5 to 84.5 percent. The output coefficient of the lateral canals and field ditches was less than 40 percent.

The large volume of construction of drainage and conveyance projects has increased the drainage capacity of the Kaidu He in the basin from 200 million to 300 million cubic meters in 1949 to 1,872,000,000 cubic meters in 1980. The average irrigation quota of the basin was as high as 1,432 cubic meters/second. A large quantity of water was drained without control. Excessive irrigation and canal leakage have, through seepage from surface layer to deep layer, supplemented the groundwater. The seepage volume from river and canal every year was 1.5 billion cubic meters, constituting 80 percent of the groundwater resources of the basin. In addition, the irrigation zone has small particle soil and a multilayer geological structure of sandwich clay layer, with extremely poor permeability. Thus, the groundwater level of the irrigation zone was drastically raised. For instance, in a soil survey of Yanqi County in 1959, the buried groundwater level of the 190,000 mu of farmland throughout the country was 2 to 3 meters deep. In a 1981 survey, the acreage of buried groundwater level at 1 meter to 1 to 2 meters deep totaled 763,000 mu, constituting 89.9 percent of the total acreage of farmland and wasteland. At present, over 50 percent of the farmland throughout the country is suffering from salinization to varying degrees, with a

a reservation rate at roughly 75 percent. The average per-unit grain output is less than 220 jin/mu.

The results of the investigation of three counties and seven farms in the Yanqi Basin which have completed their soil investigation tasks from 1979 to 1981 showed that the area of extremely mild and mild salinization constituted 64.62 percent of the area under investigation; and the area of medium and strong saline soil constituted 35.34 percent of the total area under investigation. Of course, the soil salinization in the Yanqi Basin has its natural factors,such as the saline-bearing soil quality, topographical confinement, water-salt intercommunicability, high evaporation,and so forth. Nevertheless, inappropriate water conservancy projects and excessive drainage are important reasons for speeding up secondary salinization of the soil.

B. The serious deterioriation of the system of the Bo Hu.

Bo Hu is our largest inland clear water lake. It is made up of two portions, the large lake region and the samll lake region. Its total area is 1,067 square km. The large lake region in the east stretches far into the distance. While the water level height is at 1,048 meters, the water area is 990 sqaure km, the volume is 8 billion cubic meters, and the annual evaporation is 1 billion cubic meters. The small lake region in the west is made up of over 10 small lakes and reed marshes. Over an extended process of development, the Bo Hu became a unique ecosystem of clear water lake and swamp. The lake produces over 20 types of fish for economic use. The annual fish output totals 2,000 tons. Living things used as feed are also very abundant. It has been determined that the lake has 54 phytoplanktons, 39 zooplanktons and nearly 20 aquatic tracheophyta. In particular, the water surface of the two banks of the large lake and the small lakes is covered with water lilies, (xing cai [5429 5475]) and (yan zi cat [4190 1311 5475]). The banks of the lakes are covered with green reed walls where all kinds of water fowls dwell. The environment is pretty and spectacular, and is a unique natural landscape rarely found in an inland dry region.

Bo Hu not only supplies an abundance of biological resources, but also plays a definite role in regulating the climate and preserving a fine ecological environment. However, in the last few decades, people have not fully recognized the ecological efficacy of the Bo Hu. Instead, we have treated it as an immense basin of evaporation. We have held that it is an extremely great "loss" to have 1.4 billion cubic meters of water evaporating into the air. Thus, we have all along spent time on figuring out how to reduce the volume of evaporation. For this purpose, we have carried out a series of water conservancy projects including recoursing the Kaidu He, so that the river water would bypass the Bo Hu and flow directly into the Kongque He. In 1958, the Baolang Sumu diversion sluice gate was built on the eastern tributary of the Kaidu He. This controlled the volume of water that was drained into the large lake from the eastern tributary, so that more water would flow directly into the Kongque He from the western tributary through the small lake region. After the gate was built, we reduced the drainage of water into the large lake by 400 to 600 million cubic meters every year.

Since 1965, the Jiefang No 1 Canal has been expanded on three successive occasions. This irrigation and drainage canal has been changed into a large main canal that conveys water directly to the Kongque He. Since 1975, the Jiefang No 1 Canal has carried an average of 428 million cubic meters of water annually to the Kongque He. In 1964, we built the Huangshuigou flood diversion gate, which diverted the flood water into the Kaidu He, and cut off the clear water which was draining into the lake from the northwestern portion of the large lake.

The above water conservancy projects have disrupted and undermined the recycling of the water of the Bo Hu. In addition, the excessive drainage of water and drainage of alkaline in the Yanqi Basin has continued to worsen the ecosystem of the Bo Hu.

1) The lowering of the water level and the shrinking of the lake surface.

Since liberation, the irrigation and drainage of the Kaidu He and the conveyance of water by the Jiefang No 1 Canal have reduced the volume of water draining into the lake by 30 billion cubic meters. The annual volume of water draining into the large lake has been reduced from 2.3 billion cubic meters in the 1950's to 600 to 800 million cubic meters at present.

Evaporation, however, has remained the same. More water has been drained out than in. As a result, the water level has dropped and the area has shrunk. The water level has dropped from 1,048.75 meters in 1959 to 1,046:7 meters in 1980, and the area has been reduced by 100,000 mu.

2) The increasing salinity of the lake water.

The reduction of the flow of clear water into the lake and the continuous increase of the highly mineralized water that is drained into the Bo Hu from the farmland have upset the former water-salt equilibrium of the Bo Hu. The circulation of the lake water has been changed from the former circulating state which involved primarily conveying water to the Kongque He to the stagnant state that involves primarily evaporation. The salt movement has also changed from being carried away by water to being left behind while the water drains off. As a result, the concentration and accumulation of salt has resulted in the increasing salinity of the Bo Hu.

According to a 1958 investigation by the Xinjiang Comprehensive Investigation Team, the average degree of mineralization of the water of the Bo Hu was 0.37-0.38 gl. The chemical type of the water is magnesium bicarbonate and calcium bicarbonate. The water quality is fresh. In 1975, the Xinjiang Wasteland Investigation Team collected 80 water samples from the Bo Hu for analysis. The average degree of mineralization has reached 1.4 to 1.5 gl, 3.8 times higher than 1958, with an average annual increase of 0.06 gl. The chemical type of the water has changed to sulfate, and is a mildly salty lake. In 1981, the Kaidu He Basin Comprehensive Investigation Team of the autonomous region collected nearly 100 water samples for analysis. The average degree of mineralization of the lake water rose once more to 1.8 gl.

From 1975 to 1981, the average annual increase was 0.67 gl. The degree of mineralization of the small lake region was also continuously rising.

3) The reduction of the area of reed and the decline of community.

Bo Hu is one of the famous reed producing regions in China. The reduction of the water surface and the salinization of the water quality, as well as the plundering method of utilizing reed have undermined the reed resources. The area of reed has been reduced, which naturally leads to the decline of the growth of its community and a reduction in output.

According to the materials from a 1959 aerial survey, the area of reed marshes totaled 837,600 mu. The remote sensing survey of 1981 showed that the area of reed marshes only totaled 743,800 mu, 93,800 mu less than 1959. The first- and second-category reed districts of the Bo Hu in 1959 have evolved into fourth-category reed district or pastoral area by 1981. An investigation in 1965 showed that the gross output of reed was over 400,000 tons. The gross output in 1981 was only 316,000 tons. Great changes have taken place in the area of the various types of reed. Compared to 1965, in 1981, the area of first-category reed was reduced by 57 percent; the second-category reed by 79 percent; and the third- category reed by 11 percent. In addition, the area of burnt slash and salinization totaled 65,000 mu. The absolute height of the reed was also greatly lowered. According to investigative materials in 1965, the height of the large reed was 5 to 6 meters, the highest being 6 to 7 meters, with a diameter of 1 to 1.5 cm. Some stems had a diameter of 2 cm. In a 1981 investigation, the height of the large reed was only 4 to 5 meters, with a diameter of 0.9 to 1.1 cm. Thus, we can see the seriousness of the decline of the reed vegetation.

4) The reduction of the components of the aquatic biosystem of the Bo Hu.

The deterioration of the ecological environment of the Bo Hu has affected the prosperous biological community along the shores and sub-shores of the small and large lakes. The reduction of water plants has, to a definite extent, undermined the grounds for spawning and feeding of the fishes. At the same time, it has brought about the decline of the baits which rely on water plants to live, grow and prosper. As a result, the lack of bait has also affected the fish production capacity of the Bo Hu.

The rise in the degree of mineralization of the water quality has caused the mollusc, which was abundant in the sixties, to become almost extinct: For instance, formerly, there were large numbers of (er luo bo luo [5101 5700 0592 5828]), (quan luo [5806 5828]), and (chui shi luo [2785 1395 5828]), distributed throughout the lake. Now, only some can occasionally be found near the large river mouth of the Kaidu He where it empties into the lake. The quantity of some acquatic insects and their larvae (such as the midge larva and the (xian nu chong [0103 1166 5722]) has also decreased by a wide margin. Consequently, there is an extreme poverty of benthon, and the bottom of the lake has become "deserted." Furthermore, the stenohaline and fresh water fishes have decreased or become extinct. In the 1950's and

1960's, the Bo Hu had an abundance of such unique native fish as the (da tou yu [1129 7333 7625]), while constituted over 80 percent of the gross output of fishes of the Bo Hu. In recent years, this kind of fish was rarely found and was considered to be basically extinct.

In addition, great changes have also taken place in the components of the hydrophytes and in the community of vegetation. The former fresh water plants have gradually been replaced by the halophytes. For instance, in the Huangshuiwan area, the (yan zi cai) and (za cai [569E 5475]) once grew in abundance. Now, they are mostly replaced by large algae.

III. Several Suggestions

The Kaidu He Basin is a famous water-abundant region in Xinjiang. Due to inappropriate irrigation and water conservancy projects, and to large-scale drainage and excessive irrigation, the groundwater level has generally risen and the harm of secondary salinization has become increasingly serious. This not only has affected the development of agricultural production, but also has endangered the survival of the Bo Hu. We must bear in mind this profound lesson of transforming water utilization into water disaster and superiority to inferiority, must firmly establish the thinking of guiding agricultural development according to ojbective laws, and resolutely shift the focus of water conservancy work onto complementary construction projects and irrigation management as well as onto the rational utilization of our water resources. This is the key to saving the Bo Hu, improving the ecological environment, establishing a benign cycle and promoting the development of agricultural, forestry, animal husbandry, sideline and fishery production. For this reason, we propose the following:

A. In connection with the old canals, carry out unified planning on the drainage centers along the Kaidu He and the main canals along the river, so as to prevent leakage of the canals and raise the utilization of the canal system.

B. Vigorously emphasize the complementary construction projects, launch farmland capital construction with emphasis on leveling land and digging drainage ditches. The structures of the canal system must be assembled into complete sets and repairs and maintenance must be carried out on them without delay. We must implement unified planning and management of irrigation and drainage canals.

C. Strengthen irrigation management, and implement unified management of surface and ground waters. Use water in a scientific manner, lower the irrigation quota, raise irrigation efficiency, cut down the use of surface water and enable the water to recycle in the Bo Hu.

D. The conservation volume of groundwater of the Yanqi Basin totaled 1.85 billion cubic meters. The volume of long-range recovery was 500 million cubic meters. At present, the recovery and utilization was less than 1 percent. In the future, we should vigorously recover and use the groundwater and carry

out vertical shafting for drainage and irrigation. This not only will economize the use of the Kaidu He water, but will also effectively control the rise of the groundwater level. Hence, this is an important measure in improving the soil, as well as a basic measure in increasing the emptying of fresh water into the lake, reducing drainage of water and salt from the farmland, and enhancing the freshness of the Bo Hu water.

E. Utilize the pumping station west of the Bo Hu as soon as possible and enhance the recycling of the water of the Bo Hu. For this reason, we must emphasize the completion of the construction involving the tail-end projects of the west pumping station.

---

1. Taking part in this topic's investigation are comrades La Chu [0712 0427], Ou Yun Ge Li [2962 0061 2706 7787], and Liu Zhongyi [0491 6850 5030].

2. Acknowledgement is made here to comrade Yang Lipu [2799 0448 2528], senior engineer of the Xinjiang Geographical Research Institute of CAS, for going over this article.

9335
CSO: 4008/209

ENVIRONMENTAL ENGINEERING PROBLEMS OF SHAANXI'S HANZHONG BASIN

Beijing ZHONGGUO HUANJING KEXUE [ENVIRONMENTAL SCIENCES IN CHINA] in Chinese No 1, 21 Feb 84 pp 46-51

[Article by Hu Guangtao [5170 1639 7290] of the Xi'an Geological Institute: "Geological Problems Involving Environmental Engineering in the Hanzhong Basin"]

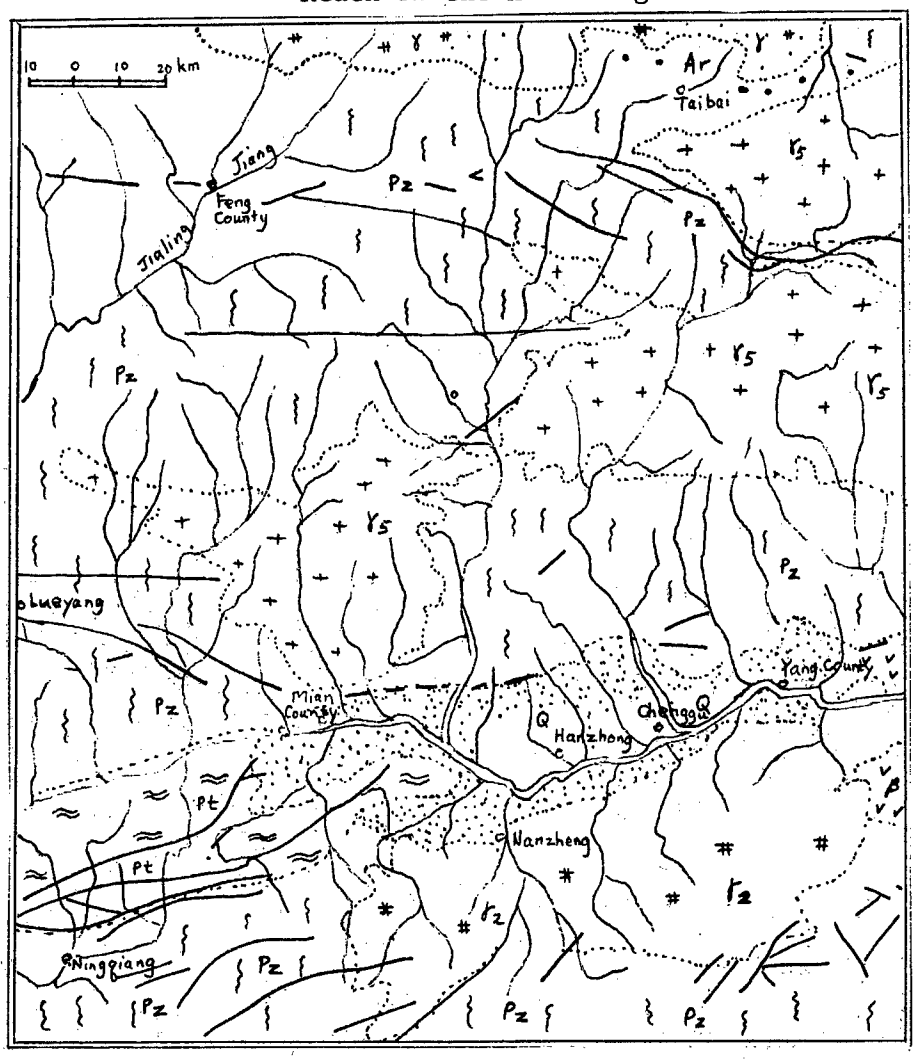
[Text] Historically, the upper reaches of the Han Jiang has enjoyed green mountains and blue waters, lovely scenery, fertile soil and a favorable climate. It may be rated as a land of charm and beauty where industry and agriculture are developed. However, in recent years, for a variety of reasons, the "natural process of river bed development" in this region has been undermined. This has markedly intensified the flood diasters of the Hanzhong Plains. During the 1950's and the 1970's, as well as over the last 2 years, the author of this article has participated in the production and teaching involving engineering construction and engineering geology and in the investigation of the flood disasters of this region. From the construction and geological standpoint, he is attempting for the first time to explore theoretically the natural factors, the characteristics of the problems, the causes of the formation and the harmful impact of environmental engineering geology. The purpose is to bring our attention to environmental protection in engineering geology, so that we can adopt relevant measures of prevention and treatment.

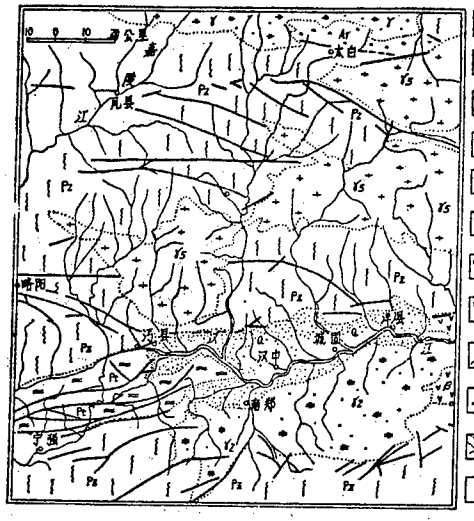
I. The Natural Environment of the Hanzhong Basin (Conditions for the Problems)

The Han Jiang originates in the Bozhong Mountains of Ningqiang. Its northern broder is the Qin Ling and its southern border is Mi Cang Shan. It joins the larger tributaries of the Yudai He, the Jushui He, the Yangjia He, the Bao He, the Lengshui He, the Wenchuan He and the Xushui He. It leaves the gorge at Mian County, travels east through Hanzhong, Nanzheng, Chenggu and other counties, and enters a small canyon at Yang County. The 120 km of flat region is the well-known Hanzhong Basin (see diagram 1).

The Hanzong Basin is surrounded by mountains. There are new and old igneous rocks, sedimentary rocks and metamorphic rocks, the primary distribution being

Diagram 1 Geological Sketch Map of the Upper Reach of the Han Jiang





Cenozoic era, Quaternary Period
Paleozoic era
Proterozoic era
Archaean group
Granite
Granite, Indo-China Era
Proterozoic granite
Basic rock
Stratigraphic boundary
The Great Fault
River
County, city

the latter kind. Of these, there are mainly schists, phyllites, argillaceous rocks and marlites, which are easily weathered and low in intensity. In the basin are distributed the diluvial and alluvial layers of the Quaternary Period. It is an east-west block basin, with folded strata running north and south. The basin has an abundant supply of phreatic water and confined water. Furthermore, toward the center of the basin, the high water quality is enhanced and the water table becomes gradually shallower. Under such geological and geomorphologic factors, as well as the weathering, peeling, breaking up, landsliding, surface erosion, and mud-rock flow, the surrounding mountainous district develop more extensively with relatively widespread distribution. There is also karst formation.

Compared to the surrounding mountainous districts, the Hanzhong Basin is a depressed region. Since the Quaternary Period, a layer of 200 to 1,000 meters of sedimentary layer has been deposited. However, compared to the lower reach of the Han Jiang, this is an elevated zone. Since the neogenic period, it has basically undergone washing and erosion by the Han Jiang. Part of the deposits in the river bed has been carried down to the lower reach. Thus, the Hanzhong Basin has been undergoing the "natural process of river bed development" in such a natural environment. However, studies have shown that this "natural process" has in recent years been undermined by artificial activities, and has become an unhealthy environmental problem in engineering geology that affects normal production and safety.

II. The Increasing Abnormality of the Artificial Activities in the Natural Environmental Changes of the Hanzhong Basin (Reasons for the Problem)

According to the analysis and preliminary research on existing materials, the artificial activities in the Hanzhong Basin has become increasingly abnormal in recent years, thus bringing about abnormality in the changes in the natural environment. This has led to the undermining of the "natural process of river bed development" in the neogenic geological history of the basin.

A. The rate of forest covering has been lowered.

Over an extended period of history, in the upper reaches of the Han Jiang, forests were destroyed through the reclamation of land. From the Zhou, Qin, Han, Ming and Qing dynasties till the time of Nationalist China, large areas of forests were destroyed. Since the nation's founding, this activity has not been checked. Statistics of the Hanzhong Region showed that the rate of forest covering in the early days of the nation's founding was above 40 percent. However, materials on forestry check in 1977 show that the rate of forest covering for the entire region has dropped to 35 percent. In particular, the opening up of wasteland on the two sides of roads and streams has been serious. This has intensified the washing of the run-offs and has expanded the primary source from which the deposits on the plains come.

B. The slopes have been further undermined:

The lowering of the rate of forest covering has weakened the protection of the slopes, thereby instensifying the landsliding and mud-rock flow in the mountainous districts as well as the two sides of the roads on the plains. Investigations of Ningqiang, Lueyang, Liuba, Chenggu, Yangxian and Nanzheng showed that large-scale landslides and mud-rock flows occurred at 19,411 places in the fall of 1981, 2,689 of which were serious. The location of development, the scale and extent of seriousness differed widely between the forest regions and unforested regions, and between the regions where there were many trees and regions where there were few trees. The rate of forest covering at Liuba was 58.8 percent. There, landslides and mud-rock flows occurred in 3,979 places. The rate of forest covering at Ningqiang was 26.1 percent. There, landslides and mud-rock flows occurred at 7,288 places. The latter was twice that of the former. The Tiesuo District in Ningqiang was situated precisely at the intersection of the fault. The rate of forest covering there was higher (at 36.7 percent). Landslides were less frequent, and took place only at 393 places. The rate of forest covering at the Beiba mountainous district in Nanzheng was as high as 62 percent. There, landslides occurred minimally.

C. Soil erosion has been intensified.

Statistics of the Shaanxi Water Conservancy Bureau from 1949 to 1979 show that the area of eroded soil was 49.9 percent of the total area of the entire region. The annual average load is 21.42 million tons. The erosion module is 791 tons/square kilometer, calculating from the total area of the entire region, and 1,651 tons/square kilometer, calculating from the area of water and soil loss. In the Hanzhong Region, there are over 288 large and small tributaries of the Han Jiang. A record of the suspended load in the 25 years (from 1956 to 1980) of the Wuhou Hydrological Station in Mian County and the Yang County Hydrological Stations as well as the hydrological stations of the various major tributaries within the region shows that: within 25 years, the load for the Wuhou Station was 19,512,000 tons, while the load of the major tributaries within the region totaled 54,735,000 tons. The combined total of the two was 151,247,000 tons. In the same period of time, the Yang County Stations at the lower reach recorded a load of 123,257,000 tons. Thus, we can see that the suspended deposit on the plains of the Hanzhong Basin at least totals 27.99 million tons. In reality, we have not included the bed loan (no information) and the mud and sand that flow in from the samller tributaries and surface flows in the region. Thus, the mud and sand accretion load on the plains of the Hanzhong Basin is far greater than what is presented here.

D. Water restriction by the projects has been excessive.

In 1975, we organized a large-scale river harnessing project on the plains of the Hanzhong Basin. We built dykes on the two sides of the Han Jiang, narrowed the river course, and restrained the water in order to increase land area. The largest flood-diversion canal of the former river course

of the Hanzhong and Nanzheng section was 2,730 meters wide. After harnessing, it was only 430 to 500 meters wide, which was 60 percent narrower than the original river course, the narrowest being over 80 percent (see diagram 2). In some cases, arbitrary building of dykes in the middle of the river was carried out outside the plan, narrowing the river course to only 360 meters. The excessive narrowing of the width of the flood-diversion canals inevitably undermined the "natural process of river bed development."

E. Inappropriate facilities have been set up on the washlands.

In recent years, we have added large numbers of construction facilities on the washlands of the Han Jiang. The unsmooth flood diversion has intensified river bed accretion. We have separately built longitudinal dykes along the two banks of the river course of the Han Jiang at Shangshuiduan, Nanzheng and Hanzhong (see diagram 3). At the lower reach near the head of the dykes as well as between the longitudinal dykes and the river banks, flood water has been diverted, the flow speed reduced, and mud and sand deposited. On the sandy shores, we have also built several concrete prefabrication plants. The workshops, production facilities and piled up prefabricated materials have seriously obstructed the water. In addition, plantation on the washlands and overgrown trees have increased the rate of roughness.

F. The river bridge projects have been inappropriately launched.

There are already four highway bridges at the upper reach of the Han Jiang. Some of the bridges are too low and others are too narrow for flood discharge. The problem of unsmooth flow eastward exists. According to the calculation of the Hanzhong Hydroelectric Bureau, the flood discharge volume of the Hanzhong Bridge in 1981 and 8665 cubic meters/second, the corresponding water level being 508.44 meters. With the same flow volume, the water level in 1962 would have been at 507.55 meters. This indicated that the water level in the former case was 0.89 meters higher. The swell at the Ximen Han Jiang Bridge in Mian County was 0.235 meters. In 1979, we built a stone arch bridge at Liuqiying over the Yan He, a tributary of the Han Jiang. In 1981, the flood-discharge swell was 1.19 meters high.

Another factor is the inappropriate piling of cubage of excavation and waste residue from the road construction in this area (no statistics as yet). Put together, these factors constitute the unhealthy environmental problem in engineering geology--namely, the abnormal change in the "natural process of river bed development."

III. The Abnormal Changes of the "Natural Process of River Bed Development" in the Natural Environment of the Hanzhong Basin (Characteristics of the Problem)

The abnormal changes of the "natural process of river bed development" in the Hanzhong Basin has become an unhealthy environmental problem in engineering geology, which is primarily manifested in the shift from river bed erosion to river bed accretion in some sections of the Han Jiang, resulting in the swell of flood and the extension of washlands.

Diagram 2 Sketch Map of the Xindu Washland in Hanzhong

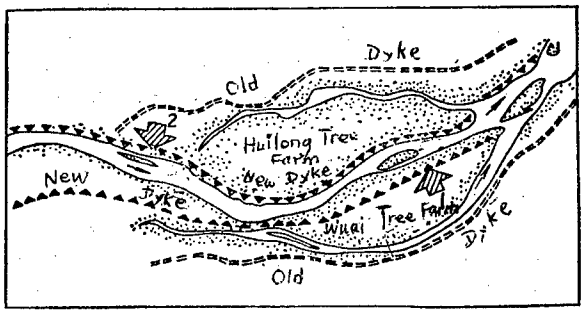
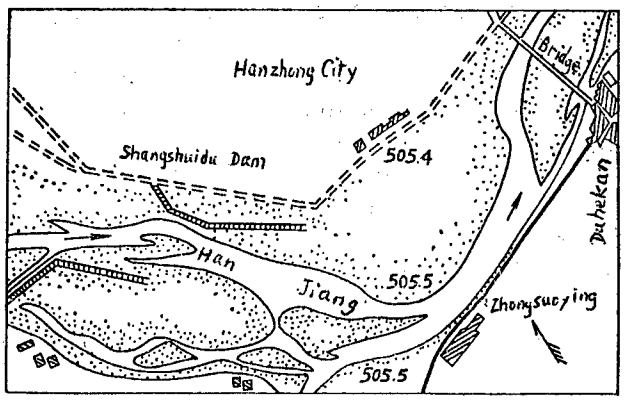


Diagram 3 Sketch Map of the Shangshuidu-Dahekan Washland in Hanzhong



A. River bed accretion

In the neogenic geological history, the river bed of the Han Jiang in the Hanzhong Basin basically underwent the natural process of washout and erosion. However, through observation in the last 50 years, we have discovered that, although the river bed west of Chenjiaying in Hanzhong and Nanzheng is still in the process of washout and erosion in the direction of upper to the lower reaches, the washout and erosion have become gradually weaker (see table 1). Inversely, east of Chenjiaying and Xindu, river bed accretion has begun, replacing the former washout and erosion, and changing the direction of the "natural process of river bed development." River bed accretion in the area around Chenggu is more extensive (see table 2). According to the analysis of the measured data in the 3 years of 1963, 1973 and 1981, in the 18 years from 1963 to 1981, the section of the Han Jiang in Chenggu showed that the hydrological cross sections of the river bed at Chenjiaba, Liangjiaan, Sijiapu, Jiangwan, Chenggu Bridge and Longwangmiao gave an average accretion of 1 meter. The accretion in the section from Jiangwan to Longwangmiao was most serious, with the highest record at 2.2 meters (see diagram 4). Accretion of the river bed also resulted in the reduction of the gradient of the river bed (see diagram 5). In 1963, the average gradient of the river bed in the Chenggu section (Chenjiaying to Longwanmiao) of the Han Jiang was 0.734 percent. By 1981, it was reduced to 0.608 percent.

B. The extension of washlands.

In recent years, the "natural process of the river bed development" of the upper reach of the Han Jiang has been undermined. This has led to changes in the washlands of the Han Jiang in the Hanzhong Basin. The area of the washlands has been expanded and the height elevated (see table 3). According to statistics, there are 17 relatively large washlands in the Hanzhong Basin. Over the last few years, the area of the alluvial flats has been expanding and the height has been increasing. Since 1963, the area of the washlands in the Chenggu section has on the average expanded from 5,687 mu to 9,562 mu.

C. The swelling of flood water.

In the neogenic geological history, the "natural process of the river bed development" of the Hanzhong Basin has been undermined. This has led to the swelling of the flood water of the Han Jiang (see diagram 6). Analyzing the flood history over the past several decades, and comparing the three relatively large floods of 1949, 1962 and 1981, we can see that (see tables 4 and 5): 1) According to the hydrological cross section materials on the floods at the Hanzhong Bridge, the flood volumes of 1949, 1962 and 1981 were similar, but the flood volume of 1949 was the largest. 2) According to the 17 hydrological cross sections of the flood water level, although the flood volumes of 1962 and 1981 were close, yet the flood water level at all sections in 1981 generally swelled conspiciously over that of 1962. The swelling at Shigong, Anjiadu and Longwangmiao was particularly obvious, with an average of over 2 meters. 3) The flood volume of 1949 was larger than that of 1981. However, the swelling of flood at all sections was higher in

Diagram 4 Cross Section of River Bed Deposits of the Han Jiang from Chenggu's Hejiacun to Longwangmiao

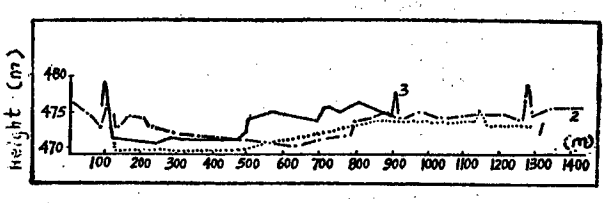


Diagram 5 Cross Section of River Bed Deposits of the Han Jiang from Chenjiaba to Longwangmiao

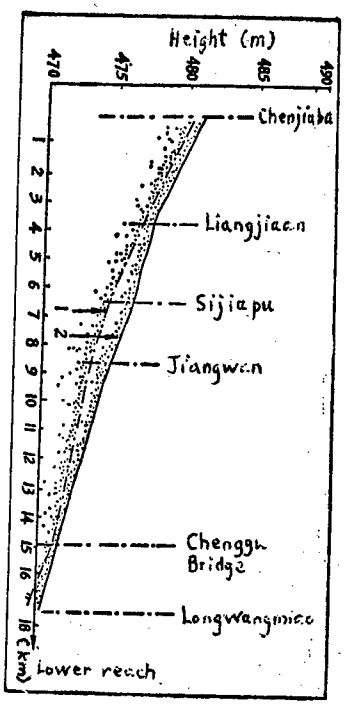


Diagram 6 The Three Flood Levels at the Chenjiaba to Longwangmiao Section of the Han Jiang

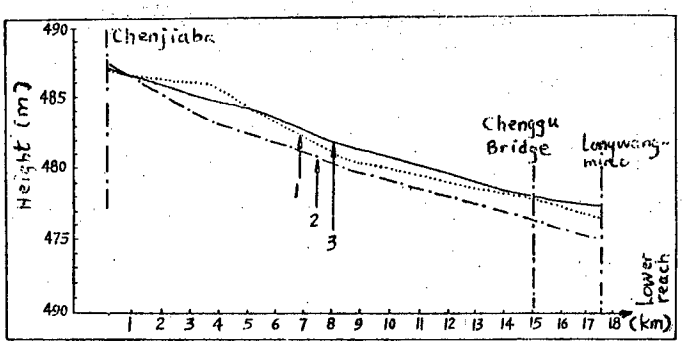


Diagram 7 Sketch Map of the Breach in the Dam at the Jiangwan to Longwangmiao Section in Chenggu (August 1981)

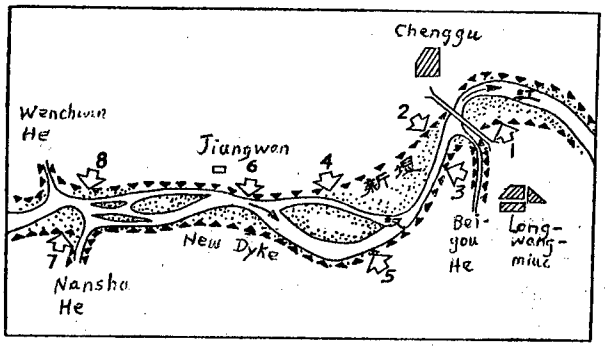


Table 1 Changes in the Washout and Accretion of the Main River Bed in the Hanzhong and Nanzheng Sections of the Han Jiang

Cross section view		Shangliangshan	Dingzhai	Shigong	Zhongsuo	Hanzhong Bridge	Weijiajing	Yuejiaba	Chenjiaying	Putaocun	Xindu	Anjiadu
Height of the main canals (m)	1929	511.25	511.84	506.29	501.92	502.72	500.05	497.80	493.88	491.56	487.65	487.00
	1974	511.25	510.59	504.44	501.86	502.29	499.27	497.17	493.95	491.37	488.53	487.03
	Ablation(-) Accretion(+)	-3.0	-1.05	-1.79	-0.56	-0.43	-0.82	-0.63	+0.07	-0.19	+0.88	+0.03

Table 2 Average Changes in the Washout and Accretion of the River Bed in the Chenggu Section of the Han Jiang

Cross Section View		Chenjiaba	Liangjiaan	Sijiapu	Jiangwan	Chenggu Bridge	Longwangmiao
Condition of ablation (-) and accretion (+)	Average height of accretion (m) in 1973 over 1963	1.52	-0.04	1.28	0.05	1.16	1.33
	Average height of accretion (m) in 1981 over 1973	-0.07	0.10	-0.38	0.09	0.20	0.89
	Average height of accretion (m) in 1981 over 1963	1.43	0.06	0.90	0.14	1.26	2.22

Table 3 Changes in the Washlands of the Hanzhong Basin

Height		Characteristics: Area of washlands (KM^2)	Height of washlands (m)	Number of washlands
Zhanglin Tan (2-7 m higher than average water level)	1929	1.920	508.8~513.5	1
	1974	2.379	508.7~514.0	1
Shijia Tan (roughly 3m higher than average water level)	1929	0	0	0
	1974	3.19	484.30~489.16	1

Table 4 The Flow Volume of the Floods at the Hanzhong Bridge in History

Time of Flood			Flow Volume (cubic meters per second)	Explanation
Year	Month	Day		
1949	9	20	10620	Results of the "Verified Reference" of the Investigation by the Chang Jiang Basin Planning Office
1962	7	19	9430	Quoted from the results of the Hydrological Calculations in the Han Jiang Plan in 1970
1981	8	22	8660	The Measured Flow Volume of the Hydrological Station and the Flood Diversion Flow Volume at Duanjiaying

Table 5 The Water Tables for the Three Major Floods of the Han Jiang in the Hanzhong, Nanzheng and Chenggu Sections

Hydrographic cross section	Flood level (m)			Comparison	
	1949	1962	1981	1981 over 1949	1981 over 1962
Shangliangshan	521.40	520.71	521.14	−0.26	0.43
Dingzhai	516.62	516.24	517.65	1.03	1.41
Shigong	510.63	510.23	512.24	1.61	2.01
Zhengsuo	509.63	508.97	510.60	0.97	1.63
Hanzhong Bridge	509.20	507.55	508.44	−0.76	0.89
Weijiajing	506.46	505.71	506.48	0.02	0.77
Yuejiaba	503.98	503.63	504.71	0.73	1.08
Chenjiaying	500.80	500.16	501.26	0.46	1.10
Putaocun	496.71	495.72	497.52	0.81	1.80
Xindu	496.03	494.08	495.37	−0.66	1.29
Anjiadu	492.57	490.93	492.96	0.39	2.03
Chenjiaba	486.87	487.32	487.10	0.23	−0.22
Liangjiaan	485.76	483.26	484.79	−0.97	1.53
Sijiapu	482.66	481.50	483.04	0.38	1.54
Jiangwan	480.50	480.01	481.65	1.15	1.64
Chenggu Bridge	478.05	476.55	478.01	−0.04	1.46
Longwangmiao	476.63	475.20	477.45	0.82	2.25

1981. In particular, the swelling of flood at Dingzhai, Shigong and Jiangwan was obvious, with an average of over 1 meter. 4) The average water surface gradient of the flood in 1981 was obviously slower than that of 1949 and 1962, displaying a state of swelling.

IV. Impact of the Abnormal Changes of the "Natural Process of the River Bed Development" in the Natural Environment of the Hanzhong Basic (Effect of the Problem)

The undermining of the "natural process of the river bed development" of the Hanzhong Basin has led to an unhealthy environmental problem in engineering geology. This has been a long-standing problem. However, only in recent years, due to its obvious development and notable impact, as well as the development of precise methods of observation and the accumulation of more and more materials, have we been able to discover and put forth the problem. This article has for the first time presented this environmental problem in engineering geology of the Hanzhong Basin as simply a problem involving the undermining of the "natural process of the river bed development" by local artificial activities. In ordinary times, the impact is relatively small and therefore not easily detected. However, during floods, the extent of disaster will be intensified and the scope of disaster will be extended.

Historically, the Hanzhong Basin has had many flood disasters. Since the nation's founding, we have recorded the above-mentioned three rather major floods which have resulted in disasters. Among the three floods, the peak flow of the flood in August 1981 was smaller than the peak flow of the flood in September 1949 and in July 1962. However, the condition of the disaster of the former was far more extensive than the latter two. Although there are many reasons (many factories and enterprises were built on the alluvial flats), yet, one important reason is the role of the unhealthy environmental problem in engineering geology in this area, which has exacerbated the losses of the disaster. According to the statistics of the Hanzhong region, the flood in August 1981 involved the 11 counties (cities) in the entire region, among which 9 counties (cities) suffered from serious disaster. Villages and towns, farmland, weirs and canals, reservoirs, generating stations, roads, factories and mines, and trading systems were destroyed, resulting in serious losses. These economic losses which were incurred overnight totaled 1 billion yuan, the greater part of which was brought about by flood disasters on the plains. The map drawn up by Hanzhong region of the Hanzhong and Nanzheng sections that were flooded has provided us with meaningful evidence. The total area flooded in September 1949 was 30.43 square kilometers. The total area flooded in July 1962 was 13.98 square kilometers. The total area flooded in August 1981 was 57.56 square kilometers. While the latter suffered from flood of the smallest scale, the area flooded was 4.1 times that of July 1962 and 1.2 times that of September 1949. In addition, there were over 4,600 breaches found in the dams. Although there are many reasons for breaches in the dams, one direct cause is the unhealthy environmental engineering geological problem in this area. The breaches were of tremendous scale, with the length varying from 10 to 1,000 meters (see diagram 7).

V. Conclusion

Along with economic development, artificial activities involve a broader region, a larger scale, a more profound depth and a greater number of factors, more intensely and conspicuously causing the abnormal changes in the ecological balance and the geological "natural process" both in the direction and the extent of development. The primary manifestation is in the change in the engineering geological environment, which may be beneficial toward mankind's production, livelihood and survival. Or, inversely, the changes may pose a harmful threat. The primary task of environmental engineering geology is to expose the law of occurrence and development of a geological environment to rationally develop and utilize the geological environment so that it will change in a direction that will favor an ecological balance, normal production, healthy livelihood and safe survival. It should prevent and restrict its harmful aspects. This means we must be able to forsee the possible changes in the geological environment that are brought about by artificial activities. In putting forth for the first time the environmental problem in engineering geology of the Hanzhong Basin, the author has analyzed and studied the problem of the impact of artificial activities on the geological environment of that region, primarily the unfavorable changes that undermined the "natural process of river bed development," which have obviously intensified the flood disasters of that region.

The construction projects and production activities in the upper reach of the Han Jiang should be carried out according to the ecological balance and geological law of "natural process" of that region. In order to reduce and prevent flood disasters in this region, besides adopting effective engineering measures, we must emphasize the increase in the rate of forest covering in order to prevent and treat the undermining of slopes, reduce water and soil loss, transform water restriction projects, clean up facilities on the washlands, and readjust the river bridge projects.

The environment for engineering geology, for the most part, is not the ground or realm that involves a single project or activity. It is not a zone that can be developed, utilized, transformed and controlled by a sector. Thus, in order to effectively develop, utilize, transform and control the geological environment, besides observing the ecological balance and geological law of "natural process," we must also strengthen socialist cooperation, and formulate the rules and regulations on the protection and utilization of the environment and resources for all, in order to prevent or minimize the occurrence of unhealthy environmental problems in engineering geology. The state environmental sciences organizations should put the study of environmental engineering geology on their daily agenda without delay and launch the work vigorously.

The "natural process of river bed development" of the Han Jiang in the Hanzhong Basin has been undermined. The accretion of river bed, the extension of washlands and the swelling of flood have become unhealthy environmental problems in engineering geology of that region. Inversely, that region is also attempting to weaken these unhealthy and harmful environmental

engineering geological problems. The reservoir which has been built has been effective in retarding, weakening and crossing the flood. At the same time, it has played the role of washing and cleaning up aggradation in the lower reach of the dam. The Shimen Reservoir on the Bao He, which originally did not shoulder the task of flood control, has retarded 35 million cubic meters of flood during the flood on 21 August 1981, weakened the flood by 1510 cubic meters/second, and crossed the flood for approximately 4 hours. This has greately reduced the flood disaster of the lower reach. During ordinary times, the discharge of reservoir water can also wash away a portion of the mud and sand deposits. To prevent or cut down the unhealthy environmental problems in engineering geology of the Hanzhong Basin, we can build dams on an appropriate scale. This way, we can even attain the goal of rationally and comprehensively utilizing water conservancy resources.

Major References

1. Zhang Zhuoyuan (1728 0213 0337], et al. Principles of Engineering Geological Analysis, Geological Publishing House, 1981.

2. Gu Dezhen [6253 1795 2182], Petrographic Engineering Geomechanics, Science Publishing House, 1979.

3. Liu Guochang [0491 0948 2490], Regional Engineering Geology in China, Geological Publishing House, 1964.

4. Liu Guochang, "Certain Problems Concerning Environmental Engineering Geology," Hydrological Geology and Engineering Geology, No 5, 1982.

5. Hu Guangtao, et al., Hydrological Geology and Engineering Geology, China Industrial Publishing House, 1965.

Acknowledgements: This article has used as reference the actual materials of the following engineers: Wang Chunxian [3769 2504 7359], Wang Shebiao [3076 5287 2871], Wang Huizhi [3769 1979 2535], Zheng Guangyu [6774 0342 1342], Ma Zonglin [7456 1350 2651] and Ji Yinsheng [0679 1377 3932].

9335
CSO: 4008/209

AUTHOR: JIANG Junfeng [3068 0193 6646]

ORG: Computer Division, Wuhan Science and Technology Center

TITLE: "A New Approach to Organizing Microinstructions in Firmware Engineering"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese No 4, Jul 84 pp 1-6

TEXT OF ENGLISH ABSTRACT: Starting from the hardware configuration of the computer, a variety of hierarchies of control information at the micro-programming level is considered, the formal definition of microoperations is developed and the microinstructions are organized based on the physical parallelism between microoperations. Such microinstructions are complete and full in describing the computer inherent parallelism. Therefore, they can be used as microprogram computing resources by microprogrammers and are integrated. Two types of parallelism, physical and logical, are distinguished. The identification of the physical parallelism and the detection of resource conflicts not at the microprogram level but at the microinstruction level are useful for increasing the flexibility of microprogramming and the efficiency of microprograms, and for realizing the project of high level microprogramming languages.

AUTHOR: YANG Jiayuan [2799 1367 3293]
LIN Daofa [2651 6670 4099]
NIE Jiansun [5119 0256 5549]
et al.

ORG: All of Sichuan University, Chengdu

TITLE: "Study of a New FFT Algorithm with Minimum Complex Coefficients"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese No 4, Jul 84 pp 35-42

TEXT OF ENGLISH ABSTRACT: G. Bruun's new FFT algorithm with a minimum of complex coefficients is studied. A formula for the real coefficients' recurrence is derived, and an output-indexing method is proposed. The algorithm is programmed and computer-simulated, and the effects of finite register length on the algorithm's realization are analyzed.

AUTHOR: HUANG Liuying [7806 2839 539]

ORG: Space Sciences and Technology Center, Chinese Academy of Sciences

TITLE: "Optimum Method of Power Division for Multisubcarrier Narrowband Phase-modulated System"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese No 4, Jul 84 pp 99-103

TEXT OF ENGLISH ABSTRACT: An optimization criterion based on analyzing the power ratio between the carrier and the various subcarriers in the narrowband phase-modulated system is derived with and without a square-wave and K sinusoidal subcarriers. This method has been applied to astronomic satellite design in the Chinese Academy of Sciences successfully.

AUTHOR: HE Zhengquan [0149 2973 2938]
WANG Zhuhong [3769 4554 4767]

ORG: Both of the Chengdu Institute of Radio Engineering

TITLE: "A Study of Acquisition Behavior for Second-order Phase-locked Loop"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese No 4, Jul 84 pp 21-28

TEXT OF ENGLISH ABSTRACT: A new method is presented for analyzing the acquisition behavior of second-order PLL with sinusoidal phase detector in the absence of noise. Based on solving approximately the nonlinear differential equation for the second-order PLL with perfect integrating filter, the approximate derivative of the decay time with respect to the frequency error is found. Then the results obtained are expanded to the second-order PLL with imperfect integrating filter, thus obtaining the expressions of the pull-in range and some approximate formulae for calculating the acquisition time for the various second-order PLL.

AUTHOR: HUANG Dongquan [7806 2639 3123]

ORG: Xian Jiaotong University

TITLE: "Tearing Method for Fault Diagnosis in Analog Circuits"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese No 4, Jul 84 pp 28-34

TEXT OF ENGLISH ABSTRACT: A new diagnosis method for analog circuits, the tearing method, is presented. An indirect measurement terminal equation is developed. The subcircuit terminal is said to be measurable if $m \geq m_2$, and the faulty branch's parameter is said to be calculable of $m = b_t + 1$. Several techniques and formulas for fault location are proposed based on consideration of the tolerances of the nonfaulty elements. This method is capable of fault diagnosis in parallel branches at a single test frequency. Fault diagnosis in ladder circuits are also discussed.

AUTHOR: ZHOU Yuanquan [0719 3293 3123]

ORG: Beijing Institute of Special Mechanical and Electrical Devices

TITLE: "A Bayesian Approach to Precision Growth"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese No 4, Jul 84 pp 51-56

TEXT OF ENGLISH ABSTRACT: The problem of estimating the precision (or variance) of a product under development testing is considered from a Bayesian approach: m sets of precision trials are performed under conditions which lead to an ordering of precisions of $h_1 < h_2 < \ldots < h_m$. The parameter of interest is h_m, the final underlying precision of the product. The marginal posterior probability density function for h_m is obtained when the conjugated type prior distribution without prior knowledge is assumed. An approximate solution is derived to meet the practical engineering needs, and the method is illustrated.

AUTHOR: CHEN Desen [7115 1795 2773]
LOU Weihong [1236 4850 7703]
SHAO Liwei [6730 0500 3634]
et al.

ORG: All of Nanjing Institute of Technology

TITLE: "Appearance Potential Spectroscopy Studies on Impregnated Dispenser Cathodes"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese No 4, Jul 84 pp 57-62

TEXT OF ENGLISH ABSTRACT: Types S and M impregnated dispenser cathodes were investigated using homemade soft X-ray appearance potential spectrometer (SXAPS), commercial X-ray photoelectron spectroscopy (XPS) and Auger electron spectroscopy (AES). The results indicate the presence of considerable differences between types S and M cathodes. It was found that in the activated type M cathode the barium and oxygen were coadsorbed on the surface, while in the activated type S cathode the surface contained both barium and barium oxide. A new Auger parameter was recommended as a characteristic parameter in determining the chemical state of barium, including activated dispenser cathodes. The substrate surface of type M cathodes appears to consist of Os/Ru covered with W which has migrated out of the pores. A model surface of monolayer barium on W was used to examine the destructive effect of the beam current used in SXAPS. No evident destructive effect was observed.

AUTHOR: MEN Shaoxiong [7024 4801 7160]

ORG: Department of Physics, Nankai University

TITLE: "Quasi Bell Transform Pseudo-color Coding in TV Technique"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese No 4, Jul 84 pp 97-99

TEXT OF ENGLISH ABSTRACT: A method of quasi-bell transform pseudo-color coding used in televisions is described. With this method one can make the pseudo-colors vary continuously as well as make the pseudo-color, corresponding to any given gray level, change abruptly and thus be an especially strong color.

AUTHOR: QIAN Enrong [6929 1869 2837]
CHEN Wanjun [7115 8001 6874]

ORG: Both of Beijing Electronic Tube Plant

TITLE: "An Investigation of Secondary Electron Emission Properties of Diamonds"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese No 4, Jul 84 pp 106-108

TEXT OF ENGLISH ABSTRACT: An investigation of secondary electron emission properties of electrically conductive as well as highly thermally conductive sintered diamond, electroplated synthetic diamond and natural diamond is described briefly. Of all the materials, the diamond shows the most favorable results for depressed collector use.

9717
CSO: 4009/65

AUTHOR: WANG Deren [3769 1795 0088]
BAI Jiandong [4101 1696 2639]

ORG: Both of Jinning Radio and Appliance Party, Nanjing

TITLE: "Integrated Design of Circulator-parametric Amplifier"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese No 4, Jul 84 pp 92-93

TEXT OF ENGLISH ABSTRACT: A unified broadband parametric amplifier has been developed by means of circulator-parametric amplifier integration. Experimental results show that the integrated design can effectively and easily obtain broadband response and decrease insertion loss and noise as well.

AUTHOR: GUO Encai [6753 1869 2088]
HAN Zhiyuan [7281 5365 0337]
YU Shuyou [0060 2885 2589]

ORG: GUO of the Central Iron and Steel Research Institute, Ministry of Metallurgical Industry, Beijing; HAN and YU both of the Research Institute, Qiqihar Steel Works

TITLE: "Influence of Nb on Steady-state Creep Behavior of Ni-Cr-Ti Type Wrought Superalloy"

SOURCE: Shenyang JINSHU XUEBAO [ACTA METALLURGICA SINICA] in Chinese No 5, Oct 84 pp A305-A312

TEXT OF ENGLISH ABSTRACT: The distribution of Nb among γ, γ' and carbide phases is found to be about 5:3:1 in the Ni-Cr-Ti type wrought superalloy of various Nb contents. With the increasing content of Nb, the stress-component, n, decreases and the apparent creep activation energy, Q_{app}, increases and fulfills the expression:

$$Q_{app} = B\ e^{kx/1ge}$$

The grain size of the alloy and the stacking fault energy of the γ matrix may be decreased by the Nb added. The steady-state creep rate, $\dot{\varepsilon}_s$, obeys the following relationship: $\dot{\varepsilon}_s \propto L^{b}\gamma_{SFE}^{\alpha}$

The volume fraction, particle radius and long range order of the γ'-phase may also be increased by the Nb added. If the effective stress $(\sigma-\sigma_b)$ is introduced to describe the stress relationship of the steady-state creep rate, the typical creep equation may be:

$$\dot{\varepsilon}_s = A_1 L^{b}\gamma_{SFE}^{\alpha}(\sigma-\sigma_b)^{n_0}\exp(-\frac{Q_{app}}{RT})$$

where σ_b is the average tensile stress opposite dislocation motion in creep.

An observation of the thin foil specimens under TEM shows that the perfect dislocation $\frac{\alpha}{2}[1\bar{1}0]$ cutting γ'-phase in glide plane (111) is resolved into two partial dislocations $\frac{\alpha}{6}[1\bar{2}1]$ and $\frac{\alpha}{6}[2\bar{1}\bar{1}]$. The spacings of superlattice dislocation pairs examined are about 100-165 Å, which nearly fit in with the measured particle size of the γ'-phase.

AUTHOR: ZHANG Yansheng [1728 1750 3932]

ORG: Institute of Metal Research, Chinese Academy of Sciences, Shenyang

TITLE: "Cryogenic Properties and Paramagnetism-Antiferromagnetism Transition of a γ-Fe-Mn-Al Alloy"

SOURCE: Shenyang JINSHU XUEBAO [ACTA METALLURGICA SINICA] in Chinese No 5, Oct 84 pp A313-A321

TEXT OF ENGLISH ABSTRACT: Studies were made of the cryogenic properties, structural stability and magnetism transition of a fcc γ-Fe-Mn-Al alloy containing 25.6 percent Mn, 4.1 percent Al, 0.16 percent C and 0.27 percent Si, of which the strength, ductility and austenitic stability were satisfactory at the temperature range of 300 to 4 K. Its physical properties were determined as follows: lower magnetic susceptibility of about 34.6×10^{-4} to 22×10^{-4} from 300 to 4 K; higher electric resistivity up to 105 μΩ·cm and lower cold contraction than conventional Fe-Cr-Ni austenitic steels. A peak value is presented on the plot of temperature T dependence of magnetic susceptibility χ at 320 K. The sign change of $d\chi/dT$ shows the paramagnetism-antiferromagnetism transition at which an anomaly of several physical properties, such as elastic modulus, heat expansion, etc., accompanies. Furthermore, by an addition of Al to the Fe-Mn alloy, its Néel temperature may be markedly lowered. The magnetic susceptibility may increase to a greater value at Néel temperature. In comparison with AISI 300 Cr-Ni austenitic stainless steels, the γ-Fe-Mn-Al alloy is characterized by both stable austenite and quite low magnetic susceptibility within the temperature range down from 20 to 4 K. It seems to be a potential construction material for superconducting magnet applications.

AUTHOR: LIU Shumo [0491 2885 2875]
CHEN Baoqin [7115 1405 3830]
BAI Ying [4101 3841]

ORG: All of the Nei Monggol Institute of Metallic Materials, Baotou

TITLE: "Effect of Rare Earth Additions on Overheating of Cr-Ni-Mo Steels"

SOURCE: Shenyang JINSHU XUEBAO [ACTA METALLURGICA SINICA] in Chinese No 5, Oct 84 pp A322-A328

TEXT OF ENGLISH ABSTRACT: The overheating behavior of several experimental Cr-Ni-Mo steels has been investigated whereby the appearance of the ductile intergranular facets on the fracture surface may be considered as a criterion of overheating. Different overheating phenomena resulted when the particles of a certain second phase dissolved in the solid solution at high austenization temperature and then reprecipitated along the prior austenite grain boundaries during cooling. It was observed in the Cr-Ni-Mo steels that the intergranular ductile fracture is caused by the reprecipitation of MnS particles in steel with ordinary S content, and the overheating is also performed by the reprecipitation of AlN or VC particles along the prior austenite grain boundaries in one containing low S. Therefore, a proposal is made that the mechanism of overheating of Cr-Ni-Mo steels seems to be related to the solution and reprecipitation of MnS, AlN or VC particles along the prior austenite grain boundaries. The RE additions may act as an inhibitor for the overheating of certain Cr-Ni-Mo steels. If the RE/S ratio reaches a critical value, namely about 4, not only is the MnS inclusion completely converted into sulphide and oxysulphide of RE, but also the prior austenite grain is remarkedly refined and toughness is improved. When the ratio is much greater than 4, the excess RE may interact with C or N atoms.

AUTHOR: WEI Xiangyun [7614 5046 0061]
HAO Huiqing [6787 1920 3237]
XIAO Yaotian [5135 5069 1131]

ORG: All of the Institute of Metal Research, Chinese Academy of Sciences, Shenyang

TITLE: "Effect of Hot Salt Corrosion on Creep Rupture Behavior of a Ni-Base Superalloy"

SOURCE: Shenyang JINSHU XUEBAO [ACTA METALLURGICA SINICA] in Chinese No 5, Oct 84 pp A365-A370

TEXT OF ENGLISH ABSTRACT: A study was made of the corrosive effect of hot salt mix of Na_2SO_4 and NaCl on the creep rupture life of a Ni-base superalloy. It was shown that for such a superalloy the rupture life is shortened, the rupture elongation is reduced and the creep rupture curve is shifted toward the left when its specimens are coated with a mixture of 75 percent Na_2SO_4 and 25 percent NaCl layer and heated under test temperatures of 750 and 800°C. No marked influence on creep rupture lives of specimens seemed to result either with 90 percent Na_2SO_4 + 10 percent NaCl under 750°C or with 95 percent Na_2SO_4 + 5 percent NaCl under 800°C. The susceptibility of the superalloy to hot salt corrosion increases when treated with electrolytic polishing. Observations under metalloscope, SEM and EMPA reveal that the effect of the hot salt corrosion on the creep rupture life of the superalloy is substantially due to the destroying of the protective oxide film on its surface, and then caused by oxidization along the grain boundaries under stress applied. Hence, the harmfulness of this corrosion effect may be affected by the surface conditions, salt composition and stress applied at elevated temperatures.

9717
CSO: 4009/64

AUTHOR: JIN Mingliang [6855 6900 5328]

ORG: Jinchuan Nonferrous Metals Company

TITLE: "Underground Mining Method Adopted in Jinchuan Mine Areas"

SOURCE: Beijing YOU KUANGYE [URANIUM MINING AND METALLURGY] in Chinese No 3, Aug 84 pp 1-10

TEXT OF ENGLISH ABSTRACT: Jinchuan Nonferrous Metal Company is the largest nickel and cobalt producing base in China. There are four main mine areas. The first and second mine areas, including one open pit mine and two underground mines (i.e., Longshou Mine and No 2 Mine) have been developed. The ore and its countryrock are rather incompact. To develop such ore bodies, vertical shafts have been sunk and drifts advanced. The cut and fill methods have been used and mechanization in mining has been experimenting with trackless haulage and the introduction of mechanized equipment.

Underground, 40 mm Gobi sandstone is mixed with cement pulp for the filling material in the filling system of the Longshou Mine, whereas in the No 2 Mine, 3 mm ground sand produced from the rod mill is mixed with cement and a little water on the ground surface to a concentration of 78-80 percent for the pipelined filling material. These two filling methods have been effectively used and carried out under control in the controlling chamber.

AUTHOR: PENG Ruqing [1756 1172 3237]
et al.

ORG: None

TITLE: "Recovery of Uranium by Thin Layer Leaching-Ion Exchange-Magnesia Precipitation Process"

SOURCE: Beijing YOU KUANGYE [URANIUM MINING AND METALLURGY] in Chinese No 3, Aug 84 pp 11-18

TEXT OF ENGLISH ABSTRACT: A technological process of thin layer leaching-resin ion exchange-MgO precipitation for recovery of uranium from some crushed ore (U 0.125 percent) is proposed. Batch test results show that >94 percent of U extraction could be obtained and the total amount of sulfuric acid consumed was about 3.8 percent (by wt) of the sampled ore of -20 mm in size. During the enlarged test, 5 kg of crushed ore of the preferred -10 mm size was well mixed with concentrated sulfuric acid followed by piling it up in a ϕ84 column of 1 m in height, and then curing it for about 24 hr at 15-20°C. Uranium was extracted by way of percolation leaching in the column by spraying tap water.

Compared with the conventional acid leaching process, the proposed process is technologically simpler and a smaller amount of waste liquor without Cl^-, NH_4^+, NO_3^-, and organic matter, etc., has to be discharged.

The leached solution was treated by ion exchange with 201 x 7 type strong base anionic resin followed by elution of the loaded resin with 1.5N H_2SO_4-100g/l MgSO as the eluting solution. Precipitation of uranium from the eluted solution was done in two stages. The preferred lime slurry (10 percent CaO) was used in the initial stage to attain pH 3.5 for 1 hr, followed by neutralization with magnesia slurry (15 percent MgO) for a final pH between 8.0 and 8.5 for 6 hr at 15-20°C. Further stirring for 1 hr led to better precipitation. The magnesium diuranate product meets all specifications set by the Nuclear Industry Ministry. The tailings may be used to refill mined out areas, etc.

AUTHOR: CHEN Shian [7115 0099 1344]
LIU Jian [0491 1696]
YU Kui [0151 6652]
LI Xueming [2621 7185 2494]

ORG: All of the Beijing Research Institute of Uranium Ore Processing

TITLE: "Treatment of Waste Water of Tailings Dam in Uranium Mill by Barium Chloride Precipitation"

SOURCE: Beijing YOU KUANGYE [URANIUM MINING AND METALLURGY] in Chinese No 3, Aug 84 pp 25-30

TEXT OF ENGLISH ABSTRACT: As a rule, some metallic cations like Mn(II or IV), Fe(III), Mg(II) or Al(III) are present to some extent in waste water from uranium mills. They can be advantageously utilized as precipitates of their hydroxides for decontamination of Ra due to their ability to flocculate and act as settling carriers to entrap microgranular $Ba(Ra)SO_4$ which has been coprecipitated by the treatment of waste water with barium chloride. If the concentrations of metallic cations in waste water are not adequate or not enough to be utilized to advantage, some inclined plate settlers or sand filters may be adopted for the removal of the suspended $Ba(Ra)SO_4$ in the waste water.

According to the compositions of most waste water from uranium mills and results from scientific experiments, a basic combinatory process for treatment of waste water in tailings dams by barium chloride precipitation is presented.

AUTHOR: DONG Yanwu [5516 3508 2976]
ZHOU Qirong [0719 0366 2837]

ORG: Both of the Beijing Research Institute of Uranium Ore Processing

TITLE: "Round Detections of Uranium Concentrations of Eluate Solutions in Some Mills"

SOURCE: Beijing YOU KUANGYE [URANIUM MINING AND METALLURGY] in Chinese No 3, Aug 84 pp 39-42

TEXT OF ENGLISH ABSTRACT: Having been used successfully in some uranium mills, a method of round detections of uranium concentrations of four or fewer eluate streams is described by means of the Uranium Auto-Analyzer with four detectors, a more recent version of the FXY-222 Uranium Auto-Analyzer with a single detector manufactured by the Beijing Nuclear Instrument Factory. Detections of each round are set at 15 minute intervals.

The precision of detection is ±2.1 percent at 1.0 g/l U and ±17 percent at 107 mg/l U in terms of relative standard deviations.

AUTHOR: XU Wuyang [1776 2976 2254]
YI Dubin [2496 4648 2430]

ORG: None

TITLE: "Centralized Control of Resin-in-Pulp Process in Certain Uranium Mill"

SOURCE: Beijing YOUKUANGYE [URANIUM MINING AND METALLURGY] in Chinese No 3, Aug 84 pp 43-49

TEXT OF ENGLISH ABSTRACT: Automatic detection and centralized control devices of resin-in-pulp (RIP) process (the air stirring adsorption stages and fixed-bed elution stages) have been used in a certain mill. These have proved effective, satisfactory and dependable. The advantages are obvious in terms of true savings in operating cost, reagent economy, stabilization of operation, better hydrometallurgical performances of the RIP process and fewer operators.

Most instruments and control devices applied are of standard and commercially-available design. Some are indigenous ones, such as signalling alarm devices for sensing height of slurry and solution level in each contacting tank (also in each slurry-discharging chamber from which the slurry is lifted out of the chamber by air to the following adsorption stage) and in each eluting tank, respectively, followed by mostly manual finger-tip control by pneumatic means. More remote detection and control devices have also been used to position traversers. An FXY-222 Automatic Uranium Auto-Analyzer has been used for on-stream detection of uranium concentration of solution in the elution stage.

It is pointed out that there is room for improvement in the centralized control of the RIP process. The electronic microcomputer control is likely to be used instead.

9717
CSO: 4009/73

AUTHOR: YANG Tonghua [2799 0681 5478]
BAO Zongyu [0545 1350 3254]

ORG: Both of the Institute of Atomic Energy, Chinese Academy of Sciences

TITLE: "A Study of Migration of Li Ions in α-$LiIO_3$ Single Crystal Under an Electrostatic Field Applied Along the c-Axis by ^6Li (n, α)t Nuclear Reaction"

SOURCE: Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese No 8, Aug 84 pp 1149-1154

TEXT OF ENGLISH ABSTRACT: Detailed information about the migration of Li ions under a DC electric field applied along the c-axis of an α-$LiIO_3$ single crystal has been obtained by analyzing the spectrum of the nuclear reaction ^6Li (n, α)t in the single crystal bombarded by thermal neutrons. The migration of Li ions in the crystal can be continuously studied non-destructively by this method. The results show that the Li ions have migrated into the Al-electrode when 0.1 Columb of charge is accumulated and have penetrated the Al-electrode at 0.3 Columb. The relative density of the Li ions at various depths in the single crystal has also been measured and compared to different amounts of accumulated charge.

AUTHOR: PAN Shaohua [3382 1421 5478]
HOU Meiying [0624 5019 5391]

ORG: Both of the Institute of Physics, Chinese Academy of Sciences

TITLE: "Electron Spin Randomization of Optically Pumped Alkali-atoms in the Spin Temperature Limit"

SOURCE: Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese No 8, Aug 84 pp 1177-1181

TEXT OF ENGLISH ABSTRACT: The behavior of electron spin randomization of optically pumped alkali-atoms in the spin temperature limit is treated theoretically in this article. Numerical solutions of the relaxation equation of motion are presented, and a generalized slowing down factor as a function of the polarization and nuclear spin is analyzed in detail.

9717
CSO: 4009/69

AUTHOR: DING Ligong [0002 4539 0501]
ZHANG Dongmei [1728 0392 2734]
XIA Wenming [1115 2429 2494]

ORG: DING of the Department of Physics, Jilin University; ZHANG and XIA both of Factory 8272

TITLE: "The Influence of Cerium on Magnetic Properties of an Optimized $ALNICO_5$ Alloy"

SOURCE: Changchun JILIN DAXUE ZIRAN KEXUE XUEBAO [ACTA SCIENTIARUM NATURALIUM UNIVERSITATIS JILINENSIS] in Chinese No 4, 5 Nov 84 pp 69-72

TEXT OF ENGLISH ABSTRACT: In this paper we report that the adding of a small amount of the rare earth element cerium to an optimized $ALNICO_5$ alloy from 0.4 *wt* percent to 1.5 *wt* percent may have an influence on magnetic properties of the alloy. We show that there is a mast proper content of Ce, and we also show that the mixed rare earth elements shown can be useful additives as well. Through the metallographic observation and electron microscopic study of the precipitated phase, we have obtained a primary understanding of the microscopic mechanism of the action of Ce on this alloy.

AUTHOR: WEI Zhenqian [7614 2182 0051]
ZHANG Zaixuan [1728 0961 1357]
LOU Yuhua [1236 3768 5478]
et al.

ORG: All of the Department of Physics and Institute of Atomic and Molecular Physics, Jilin University

TITLE: "Virtual Confocal Polarization Coupling Cavity Nd:YAG Q-Switching Laser"

SOURCE: Changchun JILIN DAXUE ZIRAN KEXUE XUEBAO [ACTA SCIENTIARUM NATURALIUM UNIVERSITATIS JILINENSIS] in Chinese No 4, 5 Nov 84 pp 79-83

TEXT OF ENGLISH ABSTRACT: A virtual confocal polarization coupling output cavity Nd:YAG pulsed repetition Q-switching laser with amplifier stage is studied and its design steps and experimental results are given in this paper. The output pulsed energy of the oscillator is 250 mJ, pulse width 12 ns, it has a TEM_{00} mode output, output pulsed energy with an amplifier stage is not less than 500 mJ, beam divergence is less than 0.5 mrad, and in near field the light spot intensity distribution is even and in far field it has a Gaussian distribution.

9717
CSO: 4009/81

END